THE

# ELECTRICAL REVIEW.

VOL. XLVI. MARCH 16, 1900. No. 1,164.

## CONTENTS:


| | PAGE |
|---|---|
| A New Phase in (British) Electricity Supply ... ... ... | 425 |
| Electric Cranes (*illustrated*) (*continued*) ... ... ... ... | 427 |
| The Pollak-Virág System of Telegraphy (*illustrated*) ... ... | 428 |
| Some Mechanical Details of Dynamo Design (*illus.*) (*concluded*) | 429 |
| The Construction of Overhead Equipments.—III. (*illustrated*) (*continued*) ... ... ... ... ... ... ... ... | 430 |
| Current Specifications.—I. ... ... ... ... ... ... ... | 431 |
| Correspondence :—What's in the Wind ... ... ... ... | 432 |
| Browett, Lindley & Co., Limited, Incorporated Oct. 9, 1890 | 433 |
| The City Road Station ... ... ... ... ... ... | 433 |
| Municipal Retrogression ... ... ... ... ... | 433 |
| Business Notes ... ... ... ... ... ... ... ... | 434 |
| The County of London Electric Lighting Company's Electricity Works (*illustrated*) (*concluded*) ... ... ... ... ... | 443 |
| Enclosed High-Speed Engine for Electric Traction at Hull (*illustrated*) ... ... ... ... ... ... ... ... | 449 |
| City Notes ... ... ... ... ... ... ... ... | 451 |
| Traffic Receipts ... ... ... ... ... ... ... | 456 |
| Stocks and Shares ... ... ... ... ... ... ... | 456 |
| Share List of Electrical Companies ... ... ... ... | 457 |
| Market Quotations ... ... ... ... ... ... ... | 458 |
| Institution of Electrical Engineers :—On the Applications of Electricity in Medical and Surgical Practice ... ... ... | 459 |
| Coal Analysis.—I. ... ... ... ... ... ... ... | 461 |
| Some Considerations Affecting the Training of Young Engineers | 461 |
| London County Council ... ... ... ... ... ... | 462 |
| An Automatic Brake (*illustrated*) ... ... ... ... ... | 463 |
| The Electric Wiring of Buildings ... ... ... ... ... | 464 |
| The Cape Tramways and the Submarine Cable ... ... ... | 465 |
| Wiring Rules and Supply Regulations ... ... ... ... | 466 |
| New Patents ... ... ... ... ... ... ... ... | 467 |
| Abstracts of Published Specifications ... ... ... ... | 468 |


THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY. Price 4d.

*The Oldest Weekly Electrical Paper.* Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4 LUDGATE HILL, LONDON.

Telegraphic Address: "AGENKAY, LONDON." Code A B C.

Telephone No. 968 Holborn.

*ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.*

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

*SUBSCRIPTION RATES.*—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 10s.

*BINDING.*—Subscribers' numbers bound, including case, for 4s. each volume.

*CASES.*—Cloth Cases for Binding can be had, price 2s. 6d. each.

*READING CASES*, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 2s., or Free by Post (in Great Britain), 2s. 6d

*FOREIGN AGENTS.*—*New York*: D. VAN NOSTRAND, 23, Murray Street. *Paris*: VEUVE J. BOYVEAU 22, Rue de la Banque. *Berlin*: ASHER & Co, 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office London, to be made payable to Mr H. ALABASTER, 4, Ludgate Hill, E.C.

## A NEW PHASE IN (BRITISH) ELECTRICITY SUPPLY.

THE account, which we conclude this week, of the City Road and Wandsworth stations of the County of London Electric Lighting Company, marks an era in the history of electricity supply in this country. The stations themselves are among the most interesting that it has been our privilege to visit, if only for the novelty and engineering skill displayed in the arrangement and control of the generating plant; but the two features which stand out most prominently are (1) the two-phase alternating current supply *to consumers*, for both lighting and power; and (2) the 530-volt direct current supply for power only.

The use of polyphase current systems for the transmission of power is not, it is true, by any means new, even in this somewhat laggard country; but we know of no previous instance in the United Kingdom where the two-phase supply has been given *direct* to the consumer. The question may be raised—Why was not the three-phase system used? To this we reply that the two-phase system will answer every purpose which may be desired, practically as well as the three-phase, while it is far superior for lighting. There is no need to balance accurately the loads on the various circuits, in order to secure constant pressure at the lamp terminals; either phase may be treated as a simple single-phase without regard for the other, whether in paralleling with existing single-phase machines or in supplying lamps. It is easy to convert a single-phase system to two-phase working, as the existing cables can be used; moreover, concentric cables with earthed outer can be used with the two-phase, but not with the three-phase system. If desired, three-phase currents may be obtained by means of stationary transformers from the two-phase mains, and rotary converters may be used to give direct currents, though with a somewhat lower efficiency than with the three-phase system.

The great advantage of the three-phase system lies, of course, in the lower cost of copper for the feeders, with equal stress on the insulating material; this, however, applies to a much less extent to the distributors, in which a neutral return is necessary for supplying lamps. Apparently, however, the greater convenience and flexibility of the two-phase system more than compensate for the greater cost, and we see it being adopted not only by the County of London Company, but also by the Metropolitan Company in its great works at Willesden, for transmission to sub-stations. Presumably the latter company also will ultimately find it advantageous to distribute a supply in both phases to certain districts.

The use of a 530-volt direct current supply on the two-wire system is, we believe, not less novel than the two-phase supply. A direct current supply, in addition to the existing alternating system, was insisted on by the Board of Trade, when the company sought powers to adopt a lower frequency. Doubtless instances have occurred in which private motors have been supplied from the generating station of an electric tramway, but that is a totally different case. Here we have the supply exclusively for private motors, with no suggestion of a trolley wire—*at present!* That there will sooner or later be a demand for supply to the various electric

tramways and railways projected in the neighbourhood, is obviously a not unreasonable supposition.

In passing, we may draw attention also to the important duties assigned to the large storage battery, which is run in parallel with the direct current generators; at times of very light load, the battery is able, by means of the motor-generators, to supply current on all three systems, enabling the whole of the engines to be stopped.

The progress of these enterprising undertakings is remarkable for its rapidity. If the present rate is maintained, the output of the City Road station alone will in four years exceed the (present) joint output of the two largest supply companies in the metropolitan area! Nor is it too optimistic a view to take that this result may actually be achieved; the wave of expansion which has overtaken the electrical industry in every branch has not yet, in our opinion, reached its climax; and we hope to see it attain to proportions as yet undreamt of. With the probable passing into law of the numerous electrical power distribution Bills, now before Parliament, will come immense developments, not only in the electrical trades, but, as we hope, in the numerous industries which will profit by cheap and handy power; the corresponding benefit to the country at large cannot fail to be of the first importance, and this, coupled with the efforts now being made by our manufacturers to maintain (not to regain—it is not lost yet, by a long way) the engineering supremacy of this country, justifies our prediction that the twentieth century will be well-named the Golden Age of Electricity.

---

Pneumatic Tools.

It is no doubt desirable in the interests of electrical industry to find as many useful applications as possible for electrical energy. It would, however, be folly to ignore other agencies, not merely because the electrical mechanician must know what other agencies are accomplishing in order that he may compete with judgment, but because other agencies are absolutely superior to electrical agencies in certain situations. It is far too much the fashion to condemn compressed air as a motive power because its efficiency is very low; but there are circumstances in which the efficiency is of small moment as compared with other advantages. Take, for illustration, the boring of the Mont Cenis tunnel through the Alps. The rock drills at the working face were worked by compressed air. This air did a three-fold work. It drove the drills, it supplied fresh air to the men where it was much needed, and it reduced the temperature at the working face. Had electricity been employed other means would have been required to ventilate the workings, and the heat generated by the electricity would to a certain, if small extent, have been undesirable. So in driving tools. There are no doubt tools, which even in the open workshop, are better air-driven than electrically. Small lifts over lathes and other tools are preferred to electrical lifts by many shop managers both here and in America, and as regards other tools there will always be a wide field where personal opinion or prejudice may influence the choice, especially if, as should be the case, both forms of energy are available. In such cases it would not be easy to say just where the line lay dividing the fields of the two powers. Mr. E. C. Amos read a paper at the recent meeting of the Institution of Mechanical Engineers that is well worth study, for in it are described and illustrated some of the many pneumatic tools to which the attention of engineers may particularly be directed. Foremost amongst these are hammers, rivetters and drills. Hammers consist of several forms of percussion tools capable of striking 1,500 to 2,000 blows per minute, and in some hammers even 10,000 to 20,000 blows per minute are secured. Such hammers may be used for chipping, caulking, beading, fettling, scaling, rivetting, stone dressing, and so on. Rivetters may be exemplified by a more than usually heavy style of hammer using air up to 100 lbs. and 125 lbs. pressure. They will drive rivets in places inaccessible to a yoke or bear rivetter. The application of air to rotary tools is proved by its excellent work in drills, such as we saw recently in the shops of the Great Eastern Railway drilling through fire-boxes for the stay holes. But one of the best applications of air in the workshop is in the small lifts over every tool of any size, to lift and support the work in progress of chucking. They entirely abolish the delay in lowering the ordinary chain blocks, and they have so little mechanism about them as to be very cheap in maintenance. Mr. Amos adds to his paper a number of estimates by practical men of the economy due to the use of these various pneumatic tools.

---

The Hire Wire System.

Suppliers of electricity are justified in availing themselves of any means of increasing their clientèle, but the circumstances surrounding electricity supply are such that the suppliers themselves do very little in the way of direct canvassing. In this respect the local wireman is a useful ally so far as securing consumers is concerned, and the hire-purchase system of wiring must also be a useful factor in increasing the output of a central station. "Free" wiring is, however, an unfortunate misnomer, and so far from being free, it is about as expensive a means of wiring a house as there is. It is, however, a very convenient method, and in houses and shops where short tenancies prevail it is distinctly useful; indeed, one may go so far as to say that without some such arrangement there are many people who would not become users of electricity. We have often heard complaints made against the system, one of the chief being that the consumer was hedged round with too many agreements. Apparently that does not appear to be always the case, for Mr. Vesey Brown has been giving in a contemporary the result of a year's experience of "free" wiring in Lincoln. It appears that the agreement which the hirer signs is not a very formidable one, for out of a total of 185 consumers connected during the year, 45 elected to be supplied under the so-called free wiring system. The charge for the wiring was 1d. per unit up to the maximum demand, and beyond that ½d. per unit. Assuming that 6d. per unit is charged, the addition of 1d. for wiring may not appear to be a very large proportionate increase, taking the average consumption of a 8-C P. lamp as 14 units per annum, a householder with 20 lamps connected would pay £1 3s. 4d. for the wiring, while, if he got no rebate, his bill for current would come to about £14. Under such circumstances the charges for wiring do not appear to be excessive; at the same time one is a little curious to know how much profit the "free" wiring agency makes out of fittings. If a consumer adopted a rental system of wiring he might be inclined to become a little extravagant regarding fittings, and we imagine that any free wiring company, if it knew its business, would not be slow to take advantage of such a fact. It is not always a disadvantage to have a working arrangement between a supply authority and a free wiring concern, for it ought certainly to tend to better work, assuming each did its duty; on the other hand, the electrical engineer is in a somewhat delicate position, and knowing how well free wiring helps to improve his load, might occasionally have a prejudice against local wiremen. There may be a good deal that is commendable in the principle of the hire-purchase system, but we think that the proper persons to carry it out are the suppliers of electricity. We are aware of the difficulties that exist in this connection, therefore one is compelled to make the best of existing arrangements. As an aid to developing the use of electricity among the poorer classes, "free" wiring may be of great use, though we should like to see its application adopted more generally by local authorities, whose duty it is to bring electricity before every inhabitant. As far as we have seen, about the only duty recognised by some authorities is to lay mains when it is likely to pay them, and not till then. We know a case where a resident in a locality in which there is a supply of electricity, applied to the Vestry to be connected on to the system, but was quietly informed that if he could get anybody else in the same thoroughfare to take electric light they might consider the question. In other words, he had to canvass the neighbourhood before the Vestry could see their way to carry out their moral duty.

## ELECTRIC CRANES.

(*Continued from page* 60.)

Fig. 25 shows a 20-ton three-motor crane, made by Messrs. Vaughan & Son, of Manchester, which is in use in Messrs. Parker's erecting shop, and fitted with Parker motors. A

Fig. 25.

view from the other side of a similar crane, of 45 feet span, is given in fig. 26.

This crane, with light loads, has a longitudinal traverse of about 300 feet per minute, and a cross-traversing motion of 150 feet per minute.

The crab sides are of cast-iron firmly stayed together, and fitted throughout with steel axles and shafts revolving in gun-metal bearings. The hoisting barrel has a right and left-hand groove to ensure a true vertical lift of the load and its equal distribution on each girder.

Steel wire rope is used in preference to chain, and the lifting hook is fitted with hardened cast-steel balls and plates under the head to permit of the maximum load being freely revolved.

The crane is spur driven throughout, and is provided with a magnetic brake similar to the one already described.

The electric equipment of the crane consists of three series-wound motors, each controlled by its own independent resistance and reversing switch. Particular attention is called to the low speeds of the crab motors, which normally run at 300 revolutions per minute. Although this necessarily makes the cranes somewhat more expensive, in consequence of the increased cost of the motors, it is claimed that the advantages obtained, such as the quicker stopping and reversing powers, longer life of the crane, elimination of high-speed gear wheels, and the consequent smoother running, more than compensate for whatever additional expenditure may be involved.

Fig. 26.

Messrs. Vaughan & Son have adopted the liquid resistance type in preference to metallic switches. The frequent renewals consequent upon the destructive sparking in connection with the latter type (even when the motor is wound specially to suit), it is stated, put them at a disadvantage when compared with the liquid resistances, where contact is made and broken upon the surface of the solution, thus obviating any sparking about the details.

One of the greatest advantages of electrically-driven cranes is their great economy of power; tests made on one of Vaughan's electric cranes reveal a mechanical efficiency of over 52 per cent. The figures given below are the results of a test made by the Electric Construction Company, Limited, of Wolverhampton, on a three-motor electric traveller made by Messrs. Vaughan & Son :—

5-ton Overhead Electric Traveller.

| Motion. | Speed. | Amperes. | Volts. | H.P. absorbed. |
|---|---|---|---|---|
| Hoisting : | | | | |
| 5½ tons ... ... ... | 5·5 ft. p. min | 28 | 100 | 3·87 |
| Light ... ... ... | 11·5 „ „ | 8 | 100 | 1·07 |
| Cross Traversing : | | | | |
| 5½ tons ... ... ... | 85 „ „ | 16 | 100 | 2·1 |
| Light ... ... ... | 110 „ „ | 6 | 100 | ·8 |
| Longitudinal Traversing : | | | | |
| 5½ tons ... ... ... | 260 „ „ | 38 | 103 | 5·2 |
| Light ... ... ... | 300 „ „ | 26 | 103 | 3·6 |

Cranes of a similar type are made by Messrs. Vaughan up to a lifting capacity of 50 tons.

*(To be continued.)*

## THE POLLAK-VIRAG SYSTEM OF TELEGRAPHY.

By Chas. H. Garland.

Leaving aside the consideration of wireless telegraphy, the trend of telegraphic invention in recent years has been always in the direction of increasing the carrying capacity of the expensive trunk lines. The inventions for this end divide themselves into two main classes. The first and most popular in Britain is the increase of the number of sets of apparatus which can be worked simultaneously on the same line. From the duplex, the quadruplex, through the Delany multiplex, up to the crowning point of Mr. Pollock's invention, the ends of the lines have spread themselves fan-wise to the extent of carrying six independent duplex sets working simultaneously.

Among the type-printing telegraphs the Hughes has been duplexed, and the Baudot has carried the multiplex system among the same class of apparatus.

The second class of inventions has run along the line of the Wheatstone automatic telegraph, the speed of which has been gradually increased up to 400 words per minute, or 24,000 words per hour. The system which I propose to describe is a development along this line which claims to transmit 100,000 words per hour. I am indebted to the courtesy of Hofrath Josef Kareis, of Vienna, for the details which follow.

The following table illustrates the relative hourly transmitting capacity of the various systems according to the Austrian computation :—

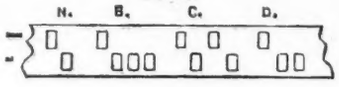
| System. | Number of telegrams of 10 words each per hour. |
|---|---|
| Morse ... ... ... ... | 25 |
| „ duplex ... ... ... | 40 |
| Hughes ... ... ... ... | 100—120 |
| „ duplex ... ... ... | 180 |
| Baudot ... ... ... ... | 400 |
| Wheatstone ... ... ... ... | 2,400 |
| Pollak-Virág ... ... ... ... | 10,000 |

A short digression is justifiable here for the purpose of drawing attention to a remarkable conflict of evidence with regard to the carrying capacity of the Morse. "The average speed," says Hofrath Kareis, "is 25 messages of 10 words each per hour, and he must be an exceptionally skilful telegraphist who can despatch 30 messages an hour." The average cost of an English telegram is 7½d., so we can assume the average length to be 15 paid words, and at least five unpaid words, or 20 words in all. Yet according to the British Post Office standard, 30 messages per hour for a competent telegraphist is "fair," 35 to 45 is "good," and under pressure he might for an hour or two continuously receive from 50 to 60 messages per hour. The actual working average, which is, of course, much affected by loss of time in other than operating work, seldom exceeds 20 messages per hour, and even this is greatly in excess of the Austrian estimate.

The Pollak-Virág system takes its name from its inventors, Anton Pollak, an Austrian electrician, and Josef Virág, a mechanical engineer. As the above table shows, the system renders possible a speed which has hitherto been regarded as impossible. Some two years ago Pollak drew the attention of the United Electrical Company, of Buda-Pesth to his system, which at that time was in an undeveloped state. The company instantly recognised the value of the invention, set up a special laboratory for further experiments, and secured for this purpose the co-operation of the able physicist and mechanician, Josef Virág. Ere long the experiments resulted in the production of the apparatus now to be described.

The sending is automatically carried out by means of a paper ribbon resembling in many respects that used for the Wheatstone apparatus. The ribbon carries two series of perforations —an upper and lower series (fig. 1), of which the upper series

Fig. 1.



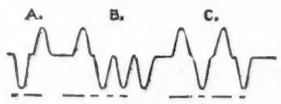




Fig. 2

represents the dashes of the Morse alphabet, and the lower series the dots. The reception is effected by means of a telephone membrane, which carries a small mirror. This mirror directs a light-ray on to a sensitised paper, and imprints a line which alternately rises and falls. The waves above the central line represent the dashes of the Morse alphabet; those below the central line represent the dots, the spacing being indicated by the straight central line (fig. 2).

The perforated ribbon is prepared by an apparatus which closely resembles that used for perforating Wheatstone ribbon, and requires no detailed description. The ribbon is inserted in an automatic transmitter, of which the essential sending parts are extremely simple. The slip passes over a metal cylinder and beneath two metal brushes. These brushes are so placed as to correspond exactly in position with the two lines of perforations. In this way the passage of a perforation allows one or other of the brushes to fall and come in contact with the metal cylinder beneath. The brush which corresponds to the upper series of perforations is joined to the positive pole of the battery, whilst the brush which corresponds to the lower series of perforations is connected with the negative pole. The metal cylinder is joined to the line. The battery is joined to earth or to a return line. It will thus happen that when a perforation of

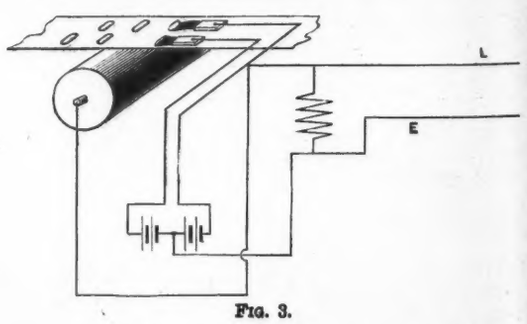



Fig. 3.

the upper series corresponding to the dashes of the Morse alphabet passes under the brush of the transmitter, the brush comes in contact with the metal cylinder and joins the positive pole of the battery to line, whilst if a perforation of the lower,

or dot, series passes, the corresponding brush will come into contact with the cylinder, and the negative pole of the battery will be joined to line. By this means currents of differing direction are sent into the receiving apparatus. Fig. 3 will make the above description more easily understood.

*(To be continued.)*

## SOME MECHANICAL DETAILS OF DYNAMO DESIGN.

By E. KILBURN SCOTT.

*(Concluded from page 345.)*

*Driving Horns.*—In smooth-core armatures the question of driving horns is an important one on account of the tangential drag on the conductors. The usual method for fixing driving horns is to snip out channels in some of the core discs, so that when built up there are several rows of

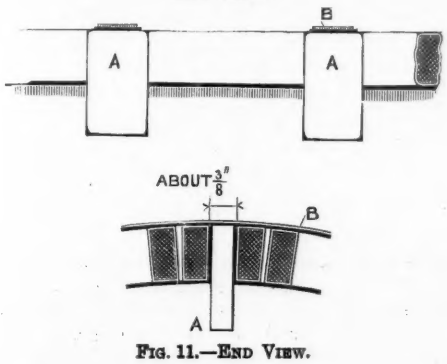



Fig. 11.—End View.

holes in the core, say, ¾ inch long, ¼ inch wide, and ⅝ths inch deep. Hornbeam pegs, A A, are driven tightly into these holes, and when the winding is completed the piano wire bindings are carried over the top, as shown at B, fig. 11.

Shallow slots are sometimes milled out right along the surface of the core, into which fibre keys are fitted, but this

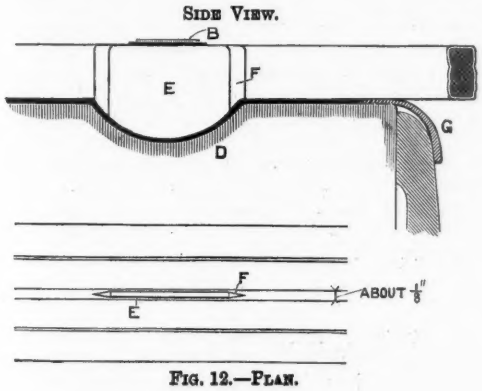



Fig. 12.—Plan.

is not recommended because at high temperatures all varieties of fibre have a nasty way of losing their nature, and the long slots also cause flats on the commutator.

In a line of dynamos which the writer designed about six years ago, the conductors were positively driven by discs of German silver driven tight into, but insulated from, the core. The method is thoroughly mechanical, and uses up very little space (see fig. 12; E is the German silver disc, F mica, D the core, and B the binding).

*Corner of Armature Core.*—The most usual place for a smooth-core armature to break down is at the corner of the core, for unless the winder is very expert he makes a botched job of the insulation on these corners on account of the unworkable nature of raw mica. The trouble can be avoided by separately forming up a ring of micanite to the radius of the corner, as shown at G in fig. 12. Longcloth and mica, arranged in three layers to thoroughly break joint, are laid in the former, stiff varnish being employed to cement the whole

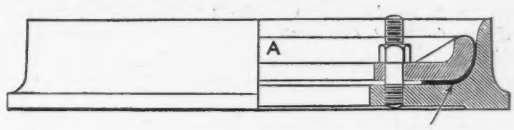



Fig. 13

together. The male plate, A, fig. 13, is then screwed down and the whole thoroughly baked.

*End Connections.*—Of the two kinds of end strip connections for bar armatures, that marked A in fig. 14 is the most

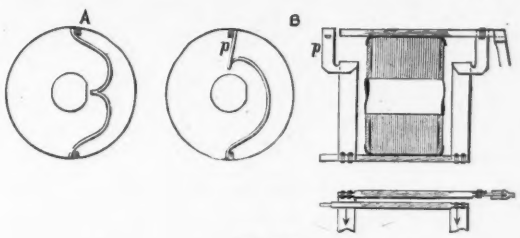



Fig. 14.

commonly used, although B has the advantage that the straight or radial part, *p*, makes an excellent fan. In cutting out the end connections from sheet copper there is always a certain amount of waste, as shown shaded in C and D and E, fig. 15. The first two show the usual method of

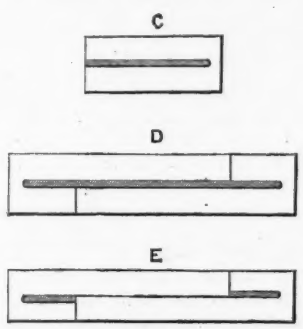



Fig. 15.

cutting out, but E, suggested by the writer, gives a saving over D of 10 or 12 per cent. in copper according to the area of the sheet.

The particular grade of hardness is an important matter

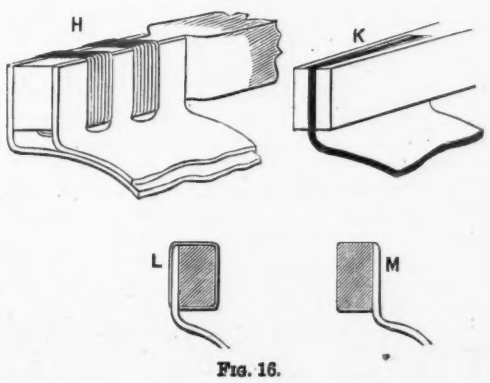



Fig. 16.

in this copper, very thin end connections being hard drawn whilst the thickest should be comparatively soft. It is not advisable, however, to have the copper sheet more than

$\frac{1}{16}$-inch thick on account of the difficulty in bending; when the output is so large as to require more than $\frac{1}{16}$-inch it is better to lay two or three strips in parallel. This is also an advantage, because the soldered joints may then be of greater area, as shown at H in fig. 16.

*Joints for End Connections.*—It has long been customary to make a saw cut in the end of the bar to receive the end connection, and although this is much easier to do now that solid copper ends are burnt on to laminated conductors, it is still very expensive. It may happen that the saw cut is a little too wide for the copper strip, with the consequence that too much solder is used, giving a high resistance joint something like K in fig. 16. A much cheaper method is that shown at L and M in fig. 16, and also at B in fig. 14. In this case the side of conductor is milled down, and the end strip after being prepared and tinned is simply laid against it, the two being then bound together by wire passed through the holes punched in the end connections. In the writer's opinion it is almost as bad to omit these bindings as to send an armature out of the winding shop without a thorough baking and insulation or break-down test.

The copper strip should be put on the side shown at L, and not as at M, or otherwise, when jointing, the solder is liable to run down into the interior of the end connections. If the above precaution of binding the joint is taken, thickening up the end connections, as shown at R in fig 17,

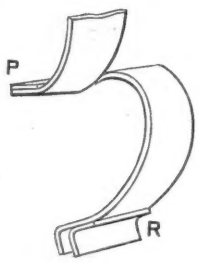



Fig. 17.

is unnecessary. The extra strip at P is also unnecessary as it uses up space which ought to be allowed for insulation, this being the part where there is considerable liability of breakdown.

Some designers mount the end connections on an insulated metal bush, fixing them up tight so that the set of end connections can be handled independently. With the radial type of end connection shown at B in fig. 14, a bush is necessary, but it can be dispensed with in the butterfly type, the connections being simply very thickly insulated and held central by a wooden ring fastened in the winding cup.

## THE CONSTRUCTION OF OVERHEAD EQUIPMENTS.

### III.

(*Continued from page* 342.)

The purpose of overhead construction is the carrying of the copper wire under which run the little grooved wheels of the trolley. The first trolleys in electrical tramway work were little trucks of brass with four wheels. They were veritable trolleys and ran on two rails, and from this early type the present single wheel trolley has lineally descended, or perhaps it should be said has ascended to its present position of 20 feet above road level. The duty of overhead construction is then simply to carry the load of the trolley wire, for the running of the trolley is merely a temporary relief to this load; it adds nothing to the stress or load, its pressure being upward. The trolley wire probably most usual in this country is that which has a diameter of 0·324 of an inch, weighs 953 lbs. per 1,000 yards, and has a cross-section 0·0824 of a square inch. It is known as No. 0 S.W.G. The usual span from pole to pole being 40 yards, and there being two trolley wires, the weight of copper per span of 40 yards is 38·12 lbs. for each wire, or 76¼ lbs. per span. This is the weight to be carried by each span wire or bracket arm.

It is a fair approximation to estimate the load at 1 lb. and an eighth per yard, for, in addition to the trolley wire, there is the weight of the two hangers, and the actual load is probably 90 lbs. per span. The trolley wire itself hangs in a true catenarian curve (fig. 15). This is the curve of free suspension of a rope or chain of equal weight throughout. It is such that

$$y = \frac{m}{2}\left(e^{\frac{x}{m}} + e^{-\frac{x}{m}}\right)$$

where $m$ is the modulus or parameter, and $e^{\frac{x}{m}}$ is the hyperbolic anti-logarithm of $\frac{x}{m}$, and $e^{-\frac{x}{m}}$ is the reciprocal of it. Thus $e^2$ is the hyperbolic anti-logarithm of 2, $e$ being the hyperbolic logarithm of 10 or 2·3026, a number which curiously is almost identical with the ratio of the pressure of water per square inch and the head in feet. The length of the arc A B

$$= \sqrt{y^2 - m^2} = x + \frac{x^2}{3\,m^2} + \frac{x^4}{5\,m^4} + \&c.$$

The parabola, however, bears so close a resemblance to the catenary that it may be substituted in all calculations. Thus in fig. 16 let the span be designated by $a$.

$y_1\ y_2$ = ordinates at point of support,
$m$ = focal distance,
$i$ = tangent at $y_1\ y_2$,
$v$ = vertical pressure on point of support,
$s$ = length from lowest point to $y_1\ y_2$,
$x_1\ x_2$ = abscissæ at lowest point,
$p$ = load per unit of horizontal length.

Then $x_1 = a\,\frac{\sqrt{y_1}}{\sqrt{y_1} + \sqrt{y_2}}$; $x_2 = a\,\frac{\sqrt{y_2}}{\sqrt{y_1} + \sqrt{y_2}}$;

$$m = \frac{a^2}{4\,y_1 + 4\,y_2 + 8\,\sqrt{y_1\,y_2}};$$

these serve for lines on a gradient.

When $y_1$ and $y_2$ are on the same level,

$$y_1 = y_2 \text{ and } x_1 = x_2 = \frac{a}{2};\ m = \frac{a^2}{16\,y_1}.$$

Calling the horizontal tension = R, then

$$\text{R} = 2\,p\,m = \frac{p\,a^2}{2\,y_1 + 2\,y_2 + 4\,\sqrt{y_1\,y_2}},$$

and the tension at the points of support

$$= \text{H} = \text{R}\,\sqrt{\left(1 + \frac{4\,y^2}{x^2}\right)}.$$

When $y_1$ and $y_2$ are equal, then

$$\text{R} = \frac{p\,a^2}{8\,y} \text{ and } \text{H} = \sqrt{\left(1 + \frac{16\,y^2}{a^2}\right)},$$

$v = 2\,p\,x$. In practice we may call $p = 1$, $a = 40$.

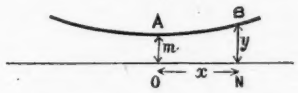
Let $y$ be assumed to be $\frac{1}{3}$, or 1 foot. Then the tension at the bottom of the curve will be $\text{R} = \frac{p\,a^2}{8\,y}$ or $\frac{1\,600}{2\frac{2}{3}} =$ 600 lbs., which is equivalent to 7,500 lbs. per square inch. Obviously the stress varies inversely as the dip, and a double tension will accompany a reduction of dip to 6 inches. The length of the curve is represented by the formula

$$\text{S} = \sqrt{\left(y + \frac{x^2}{4}\right)} + \frac{x^2}{4\,y}\ \text{hyp. log}\ \frac{y + \sqrt{\left(y^2 + \frac{x^2}{4}\right)}}{\frac{x}{2}}$$

but approximately enough for trolley wire purposes $\text{S} = x + \frac{2\,y^2}{3x}$ nearly, or $2\,\text{S} = a + \frac{8\,y^2}{3\,a}$ when $y_1 = y_2$. From this may be computed the length of wire to a span of any dip. Thus for a 40 yards span, the half length $\text{S} = 20 + \frac{2 \times \frac{1}{3}}{60}$ or

$20 + \frac{1}{270}$. The dip of 1 foot only adds, in fact, $\frac{1}{270}$ of a yard to the half length between the poles, a 40 yards span demanding 40 yards and about $\frac{3}{16}$ths of an inch besides. Very little expansion by heat adds greatly to the dip or sag. Between zero and 80° F., which may be taken as the usual outside limits in this country, the expansion of copper is about ·00000955 per degree Fahrenheit, or ·000764 of 40 yards—say, ·03 of a yard or 1 inch. This would produce a sag of 4 feet 3 inches if a wire put up at 0° with 6 inches sag were measured on a hot day at 80°. Thus is seen the importance of careful allowance for temperature, for it is evident that for each 20° difference of temperature there will be an average difference of sag of 1 foot. It is, however, probable that in a well put up line the general easement of the tension of the wire permits a part of the sag to be taken up by the recovery of the anchor poles, which straighten up a little, and by the similar straightening up of the poles round the curves. Both these factors assist in moderating the otherwise

Fig. 15.



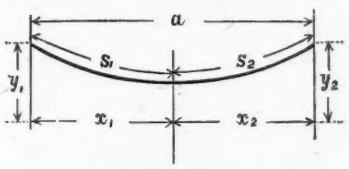




Fig. 16.

excessive differences of sag. There is also another moderating and equalising influence at work and one that has received little or no recognition. This is the expansion of the earth itself. Certain soils, such as clay, may appear to crack and dry in with heat, but the non-shrinking earths and semi-rocks undoubtedly must alter somewhat with temperature, and a very slight expansion will considerably modify the sag that would occur if the earth's surface were unalterable. One formula for calculating the dip due to temperature is as follows :—

$$y = \sqrt{\frac{3\,a\,l - 3\,a^2}{8}}$$

where $l = 2\,s$. Thus for our standard example of a 40 yards span and a wire lengthened 1 inch by temperature, we should find

$$y = \sqrt{\frac{3 \times 40 \times 40{\cdot}03 - 4{,}800}{8}} = \sqrt{\frac{3{\cdot}6}{8}} = 0{\cdot}67 \text{ yds.},$$

or just over 24 inches.

Rankine's formula for the added length necessary to produce a given additional dip is

$$\frac{2\,ds}{dy} = \frac{16\,y}{3\,a}.$$

Calling the added length 0·3 inch we have

$$\frac{2 \times 0{\cdot}3}{dy} = \frac{16\,y}{3\,a},$$

as $y$ is, say, 1 foot or 12 inches, and $a$ as before 40 yards or 1,440 inches, we find

$$\frac{0{\cdot}6}{dy} = \frac{192}{4{,}320}.$$

Hence $dy = 13{\cdot}5$ inches. Thus if we assume a dip of 12 inches already existing, the expansion of $\frac{3}{16}$ths of an inch will fully double the dip. That these dips do not take place in practice may, as stated above, be attributed to the spring of the poles round curves and the better upstanding of terminal and anchor poles as they are relieved of stress with each increase of dip.

The breaking stress of hard-drawn copper is 26 tons per square inch or 58,240 lbs. The tension of 600 lbs. above stated, or 7,500 lbs. per square inch is thus about one-eighth of the ultimate strength. The 26 tons limit is, however, apt to be reduced in the process of soldering the wire to the suspension ears, and the margin is not excessive, especially as it may happen any time that some particular span will be drawn up to an unusually small dip by the gravity of a long down-hill stretch, the spans at the top of a hill always showing more or less tautness from this cause, despite anchoring. For fuller information as to the parabola and the more correct catenarian curves of suspension, the reader may refer to Rankine's "Civil Engineering." The calculation of stress on the span wires that carry the trolley wire is very simple. In fig. 17 let A and B be two poles with a span wire between them. The load of the two trolley wires may be taken as if both were centrally spaced on the span. Assume the span to be 30 feet, and the dip to be 1 foot. Then the stress in the wire will be a little over 15 times the load. This being 90 lbs., the pull on the span wire will be 1,350 lbs. as may be shown graphically in fig. 17. Thus $y$ being 1 foot, and the half span $s$ being 15 feet to the same scale, $s$ will represent the pull on the pole, while the diagonal line $d$ is the pull in the wire. If $y = 90$ lbs., then $s = 1{,}350$, and $d$ being the hypotenuse of a right triangle will be $90 \times \sqrt{y^2 + s^2} = 90\sqrt{226}$, or 1,352·7. The stress in the wire thus varies very nearly as the reciprocal of the dip allowed.

The material and quality of span wire admit of considerable diversity of opinion. In the first place, it should be galvanised well. In order to hold the zinc when being bent and twisted to form eyes, the wires of which the rope is made should not be made of hard and strong steel of the highest class, but soft and mild steel is desirable. The waste and corrosion, especially in manufacturing districts, is very severe, and it is necessary to employ wires of large diameter, or otherwise they lose

Fig. 17.

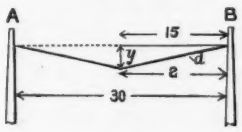


Fig. 18.

strength very rapidly when even but little corroded. A span wire stranded from seven No. 12 S.W.G. is a very usual size, but it is not so neat looking as a smaller size. A great desideratum to-day of overhead construction is a cheap, neat, and strong means of connecting a span wire to its eye. The cutting effect of wire pliers is very destructive of the galvanising. Something of the nature of Blackett's socket appears to be needed. This is a tapering steel socket, fig. 18, lined with soft metal, and it just slips over the end of the rope, which is then opened with a taper spike; the hole is filled with a cone of soft metal and the rope end then driven tightly into the socket.

The ordinary method of making an eye to a wire rope is to loop it round a horse collar thimble and tightly coil each strand round the end of the wire and the body as in telegraph construction. The only really strong joint is the regular twisted in splice which few can make, and which is too slow and costly for everyday use as it requires a long time to perform.

*(To be continued.)*

## CURRENT SPECIFICATIONS.

### I.

We have felt for some time that grave injustice is being done to the electrical engineering industry by the insertion in public contracts of clauses which limit the rights and

fetter the just freedom of the manufacturer, while in many cases they only defeat the ends they profess to serve.

It is well known that consulting engineers are often forced to insert these clauses in their specifications in order to comply with the instructions and standing orders of the public authorities for whom they act as technical advisers, and it would be as beneficial to them as to the manufacturer if these objectionable and unjust clauses were allowed to fall into disuse.

With the hope of influencing the business men composing our Town, District, and County Councils, as well as other public bodies, who are in the main the really responsible parties, we have decided in future to draw attention, from week to week, under the above heading, to any special features directly affecting electrical engineering manufacturers in the specifications which come under our notice.

We do this, feeling convinced that it is usually only necessary for the injustice of any special clause to be pointed out to ensure its omission from the final contract, and trust that our efforts may aid towards the general adoption of a set of general conditions of contracts, which shall be fair to contractor and purchaser alike.

It cannot be too strongly stated that there is no real antagonism between these apparently opposing interests, for experience proves that any curtailment of the just rights of either reacts, almost immediately, injuriously upon the other.

The disadvantages arising from the non-standard condition of affairs at present existing has been apparent for some time, and the first step towards reform was taken two years ago, when a conference was held of members of the Municipal Electrical Association representing public authorities, and the Electrical Plant Manufacturers' Association, representing the electrical industry, at which a number of clauses were mutually agreed upon, which formed a tolerably fair compromise between the various interests involved.

It is a matter of regret that these clauses have not been more widely adopted, and that some of the authorities of our largest towns and cities are prominent in their efforts to impose upon British manufacturers conditions which are inoperative when they purchase machinery from American and Continental firms, a course of action they are not at all averse to following.

We may now pass on to consider a specification under which tenders are at the present moment being invited for plant for the City of Leeds Tramways.

### City of Leeds Tramways.

This specification for the supply of several 850-kw. steam dynamos for traction work has been prepared by Messrs. Hopkinson & Talbot. There is little to comment upon in the actual specification for the plant, but in several respects the general conditions are far from satisfactory.

Clause 13 reads thus:—

**The *contractor* shall *take the risk of* and be answerable *for all accidents and damages, personal, consequential or otherwise that may occur during the progress and until the expiration of* 12 *calendar months after the entire completion of the work, and* shall repair and make good the same from time to time as soon as possible at his own cost and charge, and shall indemnify and bear the Corporation entirely harmless therefrom, whether the liability be under the Workman's Compensation Act, 1897, or otherwise, unless *the engineers shall be satisfied that the accident arises from an ascertained cause other than a defect of construction, workmanship, or material, in which case the cost shall be borne by the Corporation.***

While in Clause 25, we read:—

**In the event of any difference of opinion, doubts or disputes arising respecting the meaning or intention of the drawings or specification, or these conditions or the contract, or any part or parts thereof respectively, or respecting the quality of the materials, matters, and things to be supplied by the contractor, or the execution of the work or any part or parts thereof respectively, or respecting any other matter or thing whatsoever arising out of or incidental to the contract, the same shall be and are hereby referred to the engineers, *whose award, order and decision shall be binding and final on both parties,* and the submission hereby made shall not be revoked by either party hereto, and may be made a rule of any Divisional Court of Her Majesty's High Court of Justice, at the instance of either party to the contract, and either party to the contract may instruct counsel to appear and consent to such rule on behalf of the other party.**

In sub-section (*c*) of Clause 26, which deals with the conditions of labour to be observed by the contractor, we find that:—

**The foregoing conditions shall not apply to any trade or trades during the existence of a general lock-out in such trade or trades. *The Corporation shall be the sole judges as to whether such a general lock-out exists.***

These extracts show the general tendency of the clauses which we may at least class under the general heading of undesirable.

We have first and foremost the denial of any right on the part of the contractor to appeal to arbitration, and the placing of the Council's own engineer in the anomalous position of *judge of his own case.* This is unjust to the contractor, unsatisfactory to the Corporation since it renders it possible for suspicion as to its *bona fides* to be attached to its motives, and unfair to the engineer who thus finds his freedom hampered and his actions impugned. In this case, however, the injustice to the contractor goes farther, for in Clause 13 the onus of proof as to whether an accident occurring during the period of maintenance is due to faulty workmanship or material, is taken from the *present* user of the plant and placed on the shoulder of the *absent* contractor. An accident may often be caused by carelessness on the part of attendants, or in other ways with which the contractor may have nothing whatever to do, this cause may be unknown to the engineer and undiscoverable by him, and simply because of this, he has absolute power to make an innocent party responsible for all damages.

We suggest that all tenderers will unite in asking for the substitution for this clause of one reading something like the following, which is the standard clause agreed upon at the conference between the representatives of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association above-mentioned:—

**The contractor shall be responsible for, and shall effectually maintain and uphold in good and substantial condition, in accordance with the specification, fair wear and tear only excepted, all and every part of the contract works for a period of 12 months from the date of completion of the contract as certified by the engineer.**

The stipulation in Clause 26, to which reference has been made, is also unfair. No *one* party to the contract should be the *sole* judge of any factor involved in that contract, without some right of appeal being permitted to the other party. It may be a convenience to recite here the standard arbitration clause:—

**In case any dispute or difference shall arise between the purchaser, or his engineer on his behalf, and the contractor, either during the progress of the works or after the determination, abandonment, or breach of the contract, as to the construction of the contract, or as to the reasonableness of any extra charge, or as to the withholding by the engineer of any certificate to which the contractor may claim to be entitled, then either party may, within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration, within the meaning of the Arbitration Act, 1889.**

## CORRESPONDENCE.

### What's in the Wind?

In company with most engineers, I have taken a very lively interest in the various schemes proposed with regard to the relief of the vehicular and other traffic in the metropolitan streets, and the acceleration of the postal services in and around London, and consequently I was pleased when the announcement was recently made that the old pneumatic tube, which had lain so long *perdu*, was resuscitated, and about to be utilised for its original purpose, only actuated electrically and not pneumatically. I followed the scheme carefully through the press, and was present at the lecture given by Prof. Carus-Wilson at the Langbourne Ward Club in October last, and have since eagerly looked for further information concerning it. In that, I have been disappointed, as not a word has been forthcoming; but I have hoped on, in the expectation that progress was being made, and a public announcement would be shortly heralded.

I understood from the lecture given at the Langbourne Ward Club that Prof. Carus-Wilson was the "High Priest" of the electrical scheme, and, in fact, was the consulting engineer of the company equipping the old tube. Judge of my surprise then, when attending at the Society of Arts on

Friday last, to hear this same Professor advocating the employment of the pneumatic system, and damning the electrical. If this is not an up-to-date exhibition of Vicar of Bray traits, then I'm a Boer!

Perhaps the Professor will explain. His action certainly requires it, for a more pronounced advertisement for an American system I never listened to, nor one so opposed to his previous views.

**Marcus St. John.**

[We cannot see any reason for our correspondent's complaint. He has evidently failed to perceive that Prof. Carus-Wilson was lecturing before the Society of Arts on a system not intended to carry anything in the nature of freight, but simply letters. The old pneumatic tube, on the other hand, which he heard about at the Langbourne Ward Club, was intended for freight, and after a careful perusal of the Society of Arts' paper, we have not come across any damnation of the scheme propounded for utilising this old railway by means of electric propulsion.—Eds Elec. Rev.]

---

### Browett, Lindley & Co, Limited, Incorporated October 9th, 1890.

As some misunderstanding has arisen with reference to the notice which has been issued for creditors of this company to send in their claims to the liquidator, we are requested to state that such notice applies only to the creditors of the old company (incorporated in 1890), which is being wound-up for the purpose of reconstruction only, and which has already paid off its known debts and liabilities in full, and has returned to its shareholders their full capital, together with a premium thereon, and does not refer to the new company of the same name (incorporated in 1899), formed to take over and extend the business of the old company, and which has since August 16th, 1899, been carrying on such business at Sandon Works, Patricroft, in succession to the old company.

**Addleshaw, Warburton & Co.**

---

### The City Road Station.

In these days, when we in England are scourged by prophets who are preaching the belated crusade of standardisation and interchangeability, I read with surprise and alarm your description, in last week's issue, of the above station.

> **Are things what they seem?**
> **Or is visions about?**

Here we have a station which has been building for about six years, owned by a company formed nearly 10 years ago; and yet if some much-abused municipality had managed to collect together such a mixture of machinery and systems, I wonder what the technical papers would have said. What do we find in this electrical bazaar?

*Systems.* (1) Two-phase, 2,000 volts, 50 periods for one district. (2) Single-phase, 2,000 volts, 100 periods for another district. (3) Continuous current at 550 volts with one pole earthed for power purposes.

*Machinery.* (1) E.C.C. two-phase generators. (2) Brush single-phase generators. (3) General Electric (U.S.A.) continuous current generators. (4) Various motors by the E.C.C., Brush Company, G.E.Co., and Westinghouse Company. (5) Various motor generators, makers not mentioned. (6) Brush engines, Allis engines, Chandler engines.

I would like to ask: Are we to remain for ever the laughing stock of America and the Continent in matters of this sort?

Is it necessary to instal a separate direct current system and plant for power purposes, when there is at hand a two-phase system? Above all, is it economical? Why was not a separate system of mains and plant installed for electrical cookery? Surely the shareholders would have a right to inquire as to the manner in which their money has been expended. No doubt we shall be told that the company has merely brought their station *up to date*, and that the two-phase plant is the latest addition.

But before we parade such a heterogeneous station to the engineering world, let us remember that two-phase plant was being made on the Continent before the *out-of-date* plant at this station was ordered.

**Truthful James.**

[The County of London Company is no doubt quite capable of defending itself; but if our correspondent had read the article more carefully, and had waited for the concluding instalment before rushing into print, he would have seen that (1) the company is about to replace the high-frequency plant by 50-period two-phase machines in both stations; (2) the company was compelled to provide a direct current power supply in certain districts as a condition precedent to the above change; (3) that in both cases the company has done pioneer work so far as this country is concerned.—Eds. Elec Rev.]

---

### Municipal Retrogression.

With reference to the continued opposition of the various municipal authorities, district councils, and others to the Bill of the Lancashire Electric Power Company now before Parliament, I think the public generally ought to be made acquainted with the purpose of this Bill.

I dare venture to say that practically the whole of our citizens have their eyes closed as to what it costs to produce electricity in Manchester, and those who are using it for lighting are little aware that they are paying for the electricity supplied to power users, the latter having the current for 1½d. per unit, whilst they who use it for lighting have to pay 5d. per unit.

The facts are these: The cost to produce electricity in Manchester is a little over 1½d. per unit, and a further charge for depreciation in plant and interest on loans puts another 1½d. on the cost; so the net cost is about 3d. per unit to produce it, and the Corporation actually sell it for 1½d. per unit to power users, 2d. per unit to themselves for public lighting, while the public who use it for lighting, pays 5d. per unit.

The opposition may argue that only charging 1½d. to power users is an inducement to get a day load, that may be so, but it does not say it is right, we all know the net cost of production has to be met, so this falls upon those who use it for lighting, so in face of this, where is there any inducement to discontinue the use of gas for lighting while we have to pay as much again for electricity?

We are far behind America and the Continent in electrical matters, and continued opposition to these Bills is only keeping us so much more behind. The average charge per unit in America is about ½d. per unit; compare this with our Manchester charges.

Under the present system in Manchester it cannot be altered, it is only when produced in large bulk and supplied over a large area that the price becomes less, also the day and night loads have a chance of being balanced in a system of general distribution.

Then, again, there are small country places where it will never pay to put down generating plant for the few inhabitants of such isolated places, but if the mains of the large power company pass through these small towns a supply is easily given, thus a benefit is given to everyone. Will they who oppose these schemes please say how the small rural districts are to be dealt with, or are they to remain in their present behind state for ever or until they grow into large towns?

Manchester people are great co-operators, with their wealthy co-operative societies, so on this score, instead of being the foremost in opposing this Bill, they ought to be the very ones to support it, as this scheme is practically a co-operative society in electricity. The Bill provides that all net profits, after paying 10 per cent., is divisible with the consumers, and the consumers will be given every chance of taking up shares.

A mistaken idea exists amongst many people that this company will want to pull up the streets to put in their mains. They want nothing of the kind; the company only want to supply electricity in bulk. The Corporation can lay their own mains and use it as they wish, or sell it again to the users. Thus a profit would be made, which would perhaps pay better than the present profit made by each town generating its own current.

A time will come when the present state of things must

that :—

my surprise then, when attending at the Society of Arts on



be altered to put us in line with Continental competitors, and I think the House of Commons in allowing the Bill to be read a second time acted for public benefit. The public ought to demand from their representatives why they oppose the Bill, and why are competing companies allowed in London, and there they are allowed to lay their own mains? I think that what is good for London is good for us, or even better, seeing we have the coal fields in our midst. The public in general do not know very much about these schemes, and their municipal advisers for some reason or other do their best to keep them from knowing.

Thos. Winstanley.

Manchester, *March 13th*, 1900.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending Mar. 14th, 1899 | | Week ending Mar 13th, 1900. | |
|---|---|---|---|
| Alexandria .. .. | Value £200 | Amsterdam .. .. | Value £140 |
| Amsterdam .. .. .. | 133 | Buenos Ayres. Teleg. mat. .. | 495 |
| Antwerp. Electric fuses .. | 261 | Calcutta .. .. .. .. | 502 |
| Bombay .. .. .. .. | 280 | Cape Town .. .. .. | 637 |
| ,, Teleg. mat. .. .. | 152 | Channel Islands .. .. .. | 280 |
| Boulogne .. .. .. .. | 112 | Cologne .. .. .. .. | 25 |
| Buenos Ayres .. .. .. | 6 | Copenhagen .. .. .. | 14 |
| Calcutta .. .. .. .. | 1,920 | Durban .. .. .. .. | 140 |
| Cape Town .. .. .. .. | 137 | Gothenburg. Teleg. wire .. | 20 |
| Colombo .. .. .. .. | 102 | Hamburg. Teleg. mat. .. .. | 700 |
| Dunkirk .. .. .. .. | 250 | Karachi. Teleg. mat. .. .. | 3,407 |
| Durban .. .. .. .. | 98 | Launceston .. .. .. | 46 |
| East London .. .. .. | 26 | Madras .. .. .. .. | 49 |
| Flushing .. .. .. .. | 41 | Malta .. .. .. .. | 61 |
| Genoa .. .. .. .. | 500 | Melbourne. Teleg. wire .. | 2,961 |
| Hamburg .. .. .. .. | 590 | Odessa .. .. .. .. | 150 |
| Hong Kong .. .. .. .. | 14 | Rio Janeiro. Teleg. mat. .. | 236 |
| Melbourne. Teleg. mat. .. | 210 | Rotterdam. Teleg. mat. .. | 200 |
| Montreal .. .. .. .. | 10 | Shanghai .. .. .. .. | 342 |
| Nagasaki .. .. .. .. | 2,151 | Singapore .. .. .. .. | 10 |
| Ostend .. .. .. .. | 70 | Stockholm. Teleg. wire (105 tons) | — |
| Perth .. .. .. .. .. | 56 | Sydney .. .. .. .. | 460 |
| Port Chalmers .. .. .. | 28 | Valparaiso .. .. .. .. | 112 |
| Port Elizabeth .. .. | 323 | | |
| ,, Telephones .. | 1,194 | | |
| Rio de Janeiro. Teleg mat. .. | 490 | | |
| Rotterdam. Teleg. mat. .. | 116 | | |
| Singapore .. .. .. .. | 25 | | |
| Sydney .. .. .. .. | 158 | | |
| Trieste .. .. .. .. | 150 | | |
| ,, Teleg. mat. .. .. | 28 | | |
| Wellington .. .. .. .. | 26 | | |
| Yokohama .. .. .. .. | 73 | | |
| Total .. | £9,930 | Total .. | £10,997 |

### Foreign Goods Transhipped.

Rouen. Railway elec. appts. .. £230

**Annual Dinner.** — The employés of Messrs. C. A. Parsons & Co. held their annual dinner at the Princess Restaurant, Newcastle, last Saturday week. Mr. J. G. Turnbull presided.

**Bankruptcy Proceedings.**—Notice of a first and final dividend of 5s. 9½d. in *re* Blackburn, Walker & Co., electrical and mechanical engineers, of Cleckheaton, is given in the *London Gazette*.

Mr. J. R. Ward, of 17, North Street, Brighton, has been appointed trustee in the matter of Benjamin Symmons (B. Symmons & Co.) electrical engineer of Brighton and Hove.

At the Bristol Bankruptcy Court last week the examination of Fredk. King, electrical engineer, was further adjourned on the application of the Official Receiver.

**Dissolution.** — Messrs. G. C. Allingham and W. Fennell (Allingham & Fennell, Harrow Green, Leytonstone) have dissolved partnership.

**Books Received.**—"Field Testing for Gold and Silver" by W. Hamilton Merritt. London: Crosby Lockwood & Son. 5s. net.

"The Case Against Picketing" by W. J. Shaxby. London: The *Liberty Review* Publishing Company, Limited. 1s. 6d.

**Catalogues and Lists.**—Messrs. Coxon, Schmahl and Burrell, 18, Grainger Street, Newcastle-on-Tyne, send us a useful list of metal gongs for electric bells, &c. The sizes and approximate weights of each pattern are given in tabular form.

A new pamphlet giving prices and drawings of the "Luna" arc lamps has been issued by the Electrical Company, Limited, of Charing Cross Road.

Pamphlet No. 53 of the B.T.H. Co. gives illustrations and general details of carbon feed alternating enclosed arc lamps.

The Société Française des Accumulateurs "Phénix," of 27, Rue Cavé à Levallois (Seine), have sent us a sheet of the "Phénix" accumulators, giving prices, weights, capacities, &c.

Messrs. Adams & Co., of Lowestoft, have brought out a wholesale price list of oil motors, motor parts, &c. A description is given of the Adams oil motor, which works on the Otto principle, and is manufactured for autocar work. Various parts for autocar and cycle work are also included in the list.

Messrs. W. F. Dennis & Co. have issued for the use of the trade the "Fredennis" wire gauge table and trade price list, wherein are given in a compact form a list of the various articles stocked by the firm at the London stores. The particulars include wires of all kinds and for all purposes. The issuing of this catalogue is stated "to signalise the advent of a new century." A simple form of index has been adopted for wires in general use, and buyers can easily find the gauge, cost, Imperial standard size, &c., of wire.

The Unbreakable Pulley Company has issued a revised price list of bright steel shafting.

**Cox-Walkers.**—From an account received from this firm of work carried out during the year 1899, we gather that it was one of remarkable activity both in the lighting, power, and telephone departments. From the more important contracts we select the following for mention:—An extensive plant for the Tees Union Shipping Company, Middlesbrough, comprising two direct-coupled steam dynamos, with Bellis engines, developing 175 I.H.P., which supply current for electric cranes on their wharf; two of these cranes, out of a total of eight, each to lift 5 tons, have already been erected; each crane has a 30 H.P. lifting and a 20 H.P. slewing motor, and both motions can be in operation at the same time. Bare copper mains of ·5 square inch sectional area are carried on porcelain insulators under the wharf, and special flexible couplings are provided, so that the cranes may be attached at any desired position. Motors have also been fixed for driving the fitting and joiners' shops, and a 13 H.P. motor for the circular saw. The wharf has been lighted by means of 10 3,000-C.P. double-carbon arc lamps, erected on 60-foot poles, with suitable raising and lowering gear and trimming platform; there are also about 150 incandescent lamps in the warehouses, shops and offices. The electric lighting of Leith Academy, including about 600 lamps and a considerable amount of laboratory and other demonstrating apparatus. The power for this work is supplied by two Tangye gas engines of 40 B.H., driving two dynamos, one of which is used for charging a large set of accumulators, and the other for running direct only; this engine room is used also for the purpose of demonstrating to the students the applications of electricity. The whole of the electrical plant and mains for the supply of electricity to Saltburn-by-the-Sea has been provided and erected by them. The plant consists of Crossley's special high speed electric lighting gas engines; these are supplied with Dowson gas, manufactured in an adjoining building, and space is provided in the power station for a large addition to the power. The dynamos supply current at 220 volts, and there is a large storage battery. In all about 3 miles of mains have been laid, these are for the most part concentric lead-covered and steel armoured laid direct in the ground. At the present time there is the equivalent of 1,300 lamps connected, and applications have been made for connection during the next three months of over 2,000 additional lamps. Although this station has only been running about three months, the revenue exceeds the works' cost of production, which result is obtained by careful management combined with extremely low coal consumption, it being found that one B.T.U. is produced by the consumption of less than 3 lbs. of coal, and this in spite of the fact that at present the great bulk of the current sold is supplied from the accumulators. An important advantage gained by the use of producer gas is the fact that there are no stand-by charges, as one or more engines can be started up at any time in about 5 minutes from the gas remaining in the holder, and in 10 minutes new gas can be produced in any desired quantities; it is thus possible to work these engines either at full load or not at all, so obtaining great working economy. Further mains are now to be laid down, and a third engine and dynamo and second set of cells will be required within a few months, when the station will be capable of supplying 6,000 lamps. The works have been very busy in the manufacture of switchboards for electric lighting, power, and telephone work, telephone instruments, tell-tales, &c., and during the year it has been found necessary to double the accommodation of the workshop, offices, stores, and packing departments in order that work may be turned out more promptly than has hitherto been possible. The firm are now opening a special house-wiring department in order that they may deal better with their increasing demand for this class of work.

**Electrical Imports.**—The imports of foreign electrical goods and apparatus into the United Kingdom during February last attained to a total value of £60,780 as compared with £63,153 in the preceding month.

**Hunt v. India-Rubber Company.**—Before Mr. Justice Grantham, in the Queen's Bench Division last Friday, the case of Hunt *v.* India-Rubber, Gutta-Percha and Telegraph Works Company was mentioned.—Mr. McCall, Q.C. (with him Mr. Tindal Atkinson) said he appeared for the defendants, and his learned friends Mr. Fletcher Moulton, Q.C., M.P., and Mr. Bankes for the plaintiff. They had arranged terms which he would hand in, and he asked his Lordship to give judgment according to those terms.—Mr. Justice Grantham: Certainly.—Judgment by consent accordingly.

**Madras Electric Tramways, Limited.**—Under a winding-up order made in the High Court against this company, the statutory meetings of the creditors and shareholders were held on the 9th inst. at the Board of Trade offices, Carey Street, Lincoln's Inn Fields, W.C. Mr. Winearls, Assistant Official Receiver, reported that the winding-up order was made on November 15th, 1899, upon the petition of the Electric Construction Company, Limited. A statement of affairs had been lodged under the proceedings showing unsecured debts £2,882; a fully secured debt of £78,468 to the petitioning company who held security to the value of £90,000, and debenture bonds for £41,000. After satisfying the first debenture bond-holders there was a deficit of £1,088 with regard to the claims of the second debenture holders, and consequently there would be nothing whatever for the unsecured creditors. The assets of the company consisted of the concession, land, tramway, and undertaking in Madras, held by the

contractors who were the Electric Construction Company, Limited. Those assets were estimated to have cost £119,931, and their present value was placed at £90,000. There were 86 shareholders on the London register; a sum of £14,427 had been paid on shares, and 7,760 shares had been issued as fully paid. The Indian register showed 3,147 shareholders and payments of £42,713. It appeared that 11,890 shares issued to the contractors as fully paid had been surrendered, and 2,615 shares had been forfeited for non-payment of calls, thus reducing the total share issue to £64,900. The deficiency to the contributories was returned in the accounts at £68,871. The company was promoted by Messrs. Hutchinson & Co, and was incorporated on April 2nd, 1892, with a nominal capital of £100,000 divided into £1 shares, to acquire a concession granted by the municipal authorities of Madras for the constructing and working of tramways in Madras. The first directors were Mr. Wm. Digby (chairman), Mr. S. A. Chalk, Sir M. M. Bhownaggree, M.P., Mr. W. A. Gibson, and Mr. A. Jones-Lusty. Mr. Chalk resigned office in 1895. By an agreement dated March 16th, 1892, Messrs. Digby and Chalk, who traded as Hutchinson & Company, sold the concession to Mr. F. W. Fowler as trustee for the company for £10,000 payable in cash. The agreement provided that Mr. Digby should act as chairman and that Mr. Chalk should be the managing director of the company, those two gentlemen undertaking to pay the expenses of the promotion and to subscribe for 2,000 shares. That agreement was adopted by the company on July 16th, 1892. A prospectus offering the whole of the capital for subscription was advertised in April, 1892, in England and India. The fact that Messrs. Digby and Chalk were interested as vendors was properly disclosed in the prospectus. At the first allotment, on June 14th, 1882, 17,866 shares were issued, of which number 6,000 were allotted to directors and 1,000 to the secretary of the company. It was a condition of the concession that the construction of the tramway should not be commenced until £75,000 of the share capital had been subscribed. The first allotment proved to be insufficient, and Mr. Digby, in September, 1892, proceeded to Madras with the result that a further allotment was made, and on July 3rd, 1893, it was reported to the municipality of Madras that 77,797 shares had been allotted. A parcel of 19,560 of those shares represented the nominal amount allotted as fully paid to the contractors on July 3rd, 1893. Certain shares were afterwards surrendered or forfeited, with the result that the present issued share capital of the company stood at £64,900. Under an agreement dated September 29th, 1892, the Electric Construction Company Limited, agreed to construct and equip the tramway for a sum of £59,950, of which £19,560 had been already paid in shares. The company decided to adopt the conduit system of electric traction which, it was stated, had been especially designed to meet local requirements. The building of the power station was commenced on September 18th, 1893; the construction of the permanent way of the first section of the tramway was commenced on January 10th 1894, and it was opened for traffic on May 7th, 1895. By an agreement dated September 14th, 1894, the company issued to the contractors debentures for £20,000 (part of an issue of £25,000) as security for moneys expended by them. The remaining £5,000 bonds were issued to Mr. Digby and Mr. Lusty (directors) to secure advances made, and to be made by them to the company. In August, 1894, the company found itself unable to meet payments becoming due to the contractors and various questions arose between the two parties. It was arranged to refer the dispute to Mr. Jelf, Q.C., as sole arbitrator, and it was settled by an agreement in April, 1896, by which the balance owing to the contractors was fixed at £27,000. The conduit system on section 1 of the line proved to be a failure and the overhead system had since been substituted and used over the whole line. In January, 1895, the trustee for the first debenture holders took possession of the tramway and appointed managers who had since carried on the business. The company, on January 12th, 1897, gave the contractors a first charge, ranking in front of the debentures for £25,000 and for any further sums they might advance for the purposes of the tramway. By an agreement dated February 20th, 1899, the company accepted the sum of £64,881 as the amount due to the contractors and gave them a further charge. They also issued to them as further security £8,000 second debenture bonds part of an issue of £25,000. The first three sections and parts of the fourth and fifth sections out of the six sections which it was contemplated should be made in the first instance had been completed and opened for traffic. The traffic returns furnished by the trustee for the debenture holders showed the following results:—

| One year's trading. | Gross receipts. | Number of passengers. |
|---|---|---|
| 1895-6 | £7,212 | 2,479,902 |
| 1896-7 | 7,730 | 2,758,500 |
| 1897-8 | 11,131 | 3,643,125 |
| 1898-9 | 11,916 | 3,989,961 |

The amount shown by the statement of affairs to be due to the contractors at the date of the winding up order was £78,488 in respect of which they held the specific charges of January 13th, 1897, and February 20th, 1899; the £20,000 first debentures; the £8,000 second debentures; and they also claimed to have a second charge on the £5,000 first debentures issued to two of the directors as security for a sum not exceeding £3,500 advanced by them to the company. The directors appeared to have attempted to make arrangements to pay off the debt due to the contractors and the other liabilities of the company, and with that end they entered into an agreement with the British Electric Traction Company, Limited, on March 24th, 1898, under which the latter company agreed to make advances to the tramway company for the adjustment of its outstanding liabilities. Under that agreement the British Electric Traction Company subscribed for £8,000 second debentures at £90 per cent. The negotiations for the further financing of the company, however, were not successful, and the Traction Company ultimately withdrew from the business. On February 12th, 1899, the contractors commenced proceedings for the purpose of enforcing their security as debenture bond holders, and in those proceedings the second debenture holders as well as the company were joined. The effect of those proceedings would be that in course of time the Court would direct the sale, a reserve would be fixed and the property would be disposed of to the highest bidder.

Mr. Harold Brown (Linklater & Co.), who attended on behalf of the contractors, said a special application was now pending in the Court for the sale of the property to the contractors at the amount of their claim. It was not at all probable that any purchaser at a higher sum would be obtained.

The Chairman observed that in that case there would be absolutely nothing for the other creditors. The failure of the company was attributed by the secretary to loss of revenue, and to the fact that originally the conduit system of electric traction proved unsuccessful, but at a meeting of the shareholders held last October in Madras, the view was expressed that the company had always been short of capital. At that meeting a suggestion was made that a new company should be formed, the shareholders in the old company coming forward to subscribe further funds in order to save their present investments, and that the property should be taken over and worked on entirely new lines, untrammelled by any connection with the old company.

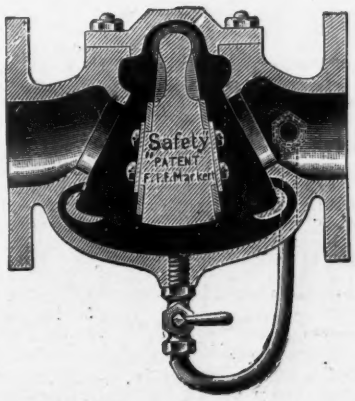
In the course of a lengthy discussion that ensued, it was stated that the application to be made shortly to the Court would be for the whole of the company's property and undertaking to be conveyed to the contractors for £80,500.

Sir M. M. Bhownaggree, M.P., urged the chairman to make an effort to have the order of sale delayed until it had been advertised in India. It was very probable that the people of that country would take up the matter and work the tramway for themselves.

The Chairman pointed out that the application to the Court would be duly notified and all parties could be represented and put forward their views to the judge.

The meeting of creditors was formally adjourned in the absence of a quorum, but the shareholders passed a resolution for the Official Receiver to act as liquidator in the usual manner.

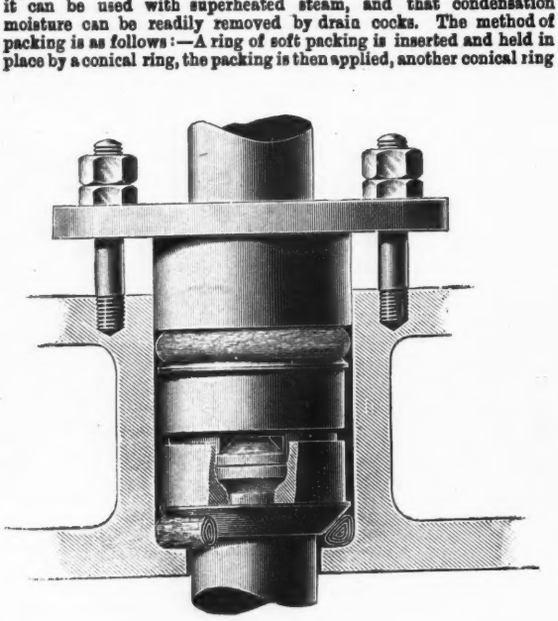
**Markert's Safety Stop Valve.**—Particulars reach us of Markert's patent safety stop valve for use on main steam pipes and between batteries of boilers to minimise as much as possible the effects of any accident to the steam pipe and engine, or of any mishap to a boiler in a battery. Accidents have frequently occurred to pipes, engines, and boilers, which, although not of themselves of serious moment, yet have been of such a nature as to cause the




blowing-off of all the steam and water from all the boilers, and the shutting down of the plant, besides occasioning injury to the employés. With this safety stop valve in use, the flow of steam is instantly stopped and the damage probably repaired within a few

minutes; or in the case of a central station, the major portion of the plant continues working, only the part where the accident or mishap occurs being affected. The working of this valve will be readily understood from the illustration on the previous page. The flap hangs in a central position, as shown, while the normal flow of steam is taking place, but any rush will instantly carry this flap to its seat and stop the flow. A by-pass is provided to admit steam back of the valve when it is desired to re-open it to continue working. This will bring the flap into equilibrium and it will then fall away from the seat to its original position. This valve may also be used as a stop valve, if occasion demands, as by means of the pointer or handle, shown outside, it can be closed and held against its seat. The valves are supplied in all sizes and for all situations by Brown and Co., 49, Deansgate, Manchester.

**Metallic Packing.**—Messrs. Brown & Co., also send us particulars of a new system of metallic packing. The advantages claimed are, that no soft packing touches the rod, that it can be used with superheated steam, and that condensation moisture can be readily removed by drain cocks. The method of packing is as follows:—A ring of soft packing is inserted and held in place by a conical ring, the packing is then applied, another conical ring



inserted with a second ring of soft packing and the gland is then screwed up. The illustration shows the general arrangement of the stuffing box. The makers ask for the following particulars:—Pressure and temperature of steam, diameter of rod, and diameter and depth of stuffing box, to enable them to quote exactly. In principle the packing is simple, and what is more to the point, durable and reliable.

**Prism Globes.**—The Prism Globe Company, Limited, has been awarded the contract for the globes and incandescent fixtures for the street lighting of St. Anne's-on-the-Sea.

**Russia.**—The Russian Customs authorities have recently given a decision to the effect that the duty to be imposed on insulators of porcelain and metal for use in connection with the electrical transmission of power is 9 roubles per pood, under article 169 of the tariff.

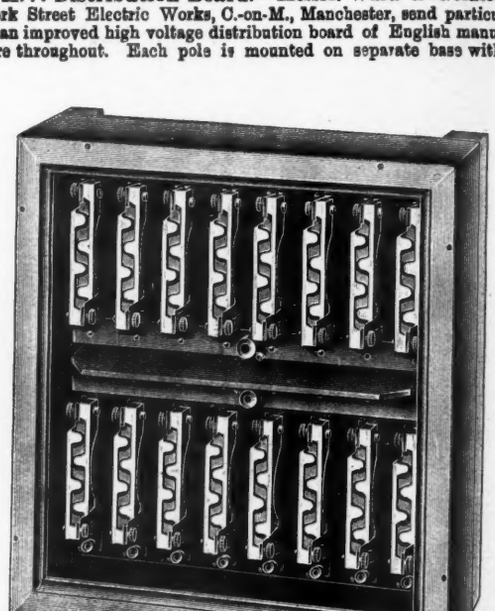
**The Society of Model Engineers.**—At the ordinary monthly meeting of this society, held at the Memorial Hall, E.C., on Thursday, March 8th, the engineering models entered for the society's competition were on view. The society's gold medal for the best model was given to Mr. W. H. Dearden, for a horizontal type gas engine; the silver medal for the best electrical model was awarded to Mr. A. M. H. Solomon for his Wimshurst machine.

**Summons.**—At the Greenwich Police Court last week the summons against the London Electric Supply Corporation, Limited, for making default in supplying electric energy to the occupier of the Dover Castle public house, Broadway, Deptford, was again adjourned. Mr. Lawless, for the prosecution, and Mr. J. Fletcher Moulton, Q.C., for the defence, agreed that the case was an important one and might occupy some time.

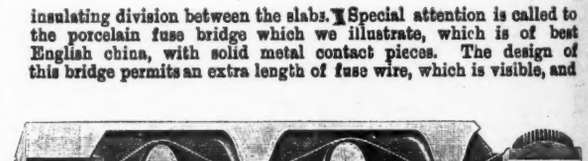
**Trade Announcement.**—Owing to increase of business, Mr. A. P. Lundberg is removing, on the 25th inst., from Bradbury Street, Kingsland, to larger premises at Pioneer Electrical Works, 477—487, Liverpool Road, N.

**Water-tube Boilers in the Navy.**—From a question put in the House by Sir F. Flannery, and answered by Mr. Goschen, it appears that the longest continuous run of a ship with water-tube boilers at full power is one made by the *Diadem* in December, 1898, when she was under way 69 hours for a distance of 1,330 knots at an average of 14·268 H.P. and a speed of 19·27 knots during which the coal consumption was 2·16 lbs. per I.H.P. and no defects were developed of any moment. What small defects were noted is not stated. They did not affect the steaming power or speed, but they did occur. Mr. Goschen went on to say that the *Powerful*, which left for China in 1897, has, in course of her commission, gone through speed trials, which, though of shorter duration, were of equal interest for she ran from Hong Kong to Manila in March, 1899, and during a run of 27 hours steamed 540 knots at 20·2 knots speed and an I.H.P. of 19,600, her coal consumption being 2·6 lbs. and no defects developed. The captain wrote very optimistically of a run of four hours at 24,000 I.H.P. for one hour, and an average of 23,000 I.H.P. in the tropics, and with not hand-picked coal. Perhaps we are not optimistic, but we confess we still feel that the Belleville boiler is not the thing for our ships. We hear about these runs of 27 and 69 hours, but we wonder what a mercantile engineer would say about them—one of those men who run engines for three weeks on end. The *Powerful* and the *Diadem* are new ships. What will they be like in a year or two when their lower tubes are all in pieces? The *Powerful* will always live in our memory as the ship that supplied the guns which enabled us to hold Ladysmith.

**H.V. Distribution Board.**—Messrs. Ward & Goldstone, York Street Electric Works, C.-on-M., Manchester, send particulars of an improved high voltage distribution board of English manufacture throughout. Each pole is mounted on separate base with an



insulating division between the slabs. Special attention is called to the porcelain fuse bridge which we illustrate, which is of best English china, with solid metal contact pieces. The design of this bridge permits an extra length of fuse wire, which is visible, and



FULL SIZE.

should the fuse blow, no damage or discoloration of the base is effected. The boards are mounted in solid oak or teak polished cases, glazed front, and present a very handsome appearance.

## ELECTRIC LIGHT AND POWER NOTES.

**Acton.**—The District Council has given its consent to the Aberystwyth and Chiswick Electric Supply Corporation supplying electric current in Woodstock Road, which is in the Council's district.

**Brighton.**—The balance-sheet of the borough electricity works for 1899 is pleasant reading. It shows that 3,815,743 units of electricity were generated during the year, of which 2,604,039 were consumed in private use, 602,584 on the public lamps, 160,630 in the works, and 448,470 not accounted for. There are 257 public arc lamps, and 1,027 incandescent. Including £229,687 15s. 1d. due to capital, the liabilities at the close of the year were £308,295 0s. 1d. The cost of generating the electricity was £17,269 11s. 9d., and of distribution £11,745 14s. 6d. Sales to the public realised £35,321 3s., while the charge against public lamps was £8,546 16s. 11d. To a

profit on the year of £16,700 must be added £6,802 0s. 7d. brought forward from the previous year, making £23,502 0s. 7d., of which interest consumes £7,146 0s. 5d., and sinking fund £8,099 1s. 5d. The sum of £2,135 was applied in aid of district rate, £170 2s. 10d. transferred to reserve fund, £4,496 17s. 9d. paid to loans fund, and £1,454 18s. 2d. carried forward. On the application of Mr. Wright, the Brighton Lighting Committee propose to modify their agreement with him, by which he will be relieved of the superintendence of details, but remain consulting engineer at the same salary as at present. Mr. Wright binds himself for five years, while the Corporation may determine the agreement by a three months' notice. On the recommendation of Mr. Wright, the Lighting Committee propose that Mr. Joyce should be acting manager of the electricity works during the absence of Mr. Fowler in South Africa.

**Bradford.**—The accounts of the electricity department for the half year ended December 31st last show that the total income was £17,654 5s. 2d., and total expenditure, including interest and sinking fund, £14,256 19s. 5d., making a net profit of £3,397 5s. 9d., an increase of £905 12s. 4½d. over the corresponding period of 1898. The price of continuous power had been reduced from 2½d. to 1d. per unit during the half-year.

**Cauvery Falls.**—The following extracts from the *Madras Daily Post* are of interest:—"Captain Lotbinière, R.E., has just returned from a six months' visit to Europe and America, whither he had been sent by the Mysore Government in connection with the great scheme for the harnessing of the Cauvery Falls at Sivasamudram. He has brought back with him a cut and dried scheme, with every detail worked out. All the firms who have tendered for the scheme have agreed to complete the whole of the work within 20 months. The contractors undertake to supply and erect all the hydraulic and electrical plant necessary to convert the energy of the water at the Cauvery Falls into electrical energy and to transmit the same a distance of 90 miles to the Kolar Gold Fields. They also engage to maintain the whole installation for a period of one year before handing over charge to the officers appointed by the Mysore Durbar. The scheme will cost something like £300,000. It is at present proposed to begin by developing at the Falls and transmitting only 4,000 H.P. to a central point on the Kolar Gold Fields. When this has been satisfactorily tried further plant will be laid down to produce another 4,000 H.P. The whole of the power will in the first instance be sold to the mining companies at Kolar, and the surplus power available (*sic*) will be utilised in various ways in the towns of Mysore and Bangalore—each of which places is only about 40 miles from the site of the power station. It is proposed to use a bare wire in the transmission of electrical energy, carried overhead on triple-petticoated porcelain insulators. It is estimated that in the course of transmission there will be a loss of power of about 33 per cent., of which 13 per cent. will be in the line. The generators proposed to be used vary from 1,000 to 1,250 H.P., with turbine and generator on the same horizontal shaft, with a guaranteed efficiency of 75 per cent., and governing within 5 per cent. By means of step-up transformers the voltage of about 2,000 at the power station will be increased to about 30,000, and at the other end of the line it will be reduced by means of step-down transformers to about 2,000 or 1,500 volts and split up again before being supplied to the units. The longest transmission line now in operation in any part of the world is that from Redlands, in California, to Los Angeles, a total distance of 83 miles—*i.e.*, seven miles less than what the Mysore scheme will be. The horse-power delivered is 4,000—exactly what is proposed for the Cauvery Falls scheme—and the voltage at present used is 40,000. This high voltage has, however, been found to give results which can hardly be considered either satisfactory or very safe, so that with this experience before them four of the firms who have submitted tenders do not propose to go over 30,000 volts, while one American firm only proposes to go up to 23,000 volts. No single part of any unit is to weigh more than 10 tons, so that there need be no special difficulties in the way of transport. The five firms who have tendered include two in Switzerland (Brown-Boveri and Oerlikon) two in America (the General Electric and the Westinghouse) and one in Berlin (the General Electric.) They all run each other very closely in the proposed details and also in the matter of cost. Immediately on reaching England Captain Lotbinière consulted Prof. G. Forbes and Prof. Unwin, and induced both these experts to act as a committee to advise him on behalf of the Mysore Durbar as to the best proposals for carrying out the work. While tenders were being prepared he set off on a tour to America. He travelled through Canada and the United States, visiting all the principal transmission schemes now in operation. He also closely inspected the utilisation of electrical power throughout the various gold and silver mining camps in the United States. The principal of these are the Cripple Creek (Gold) Mining Camp in Colorado [See Electrical Review, Vol. 45, pp. 433, 847] and the Aspen (Silver) Mining Camp. Both are in the Rocky Mountains. The Cripple Creek turns out annually gold worth about five million pounds sterling. The Aspen also has very large works, but there is not much being done there just now owing to silver having deteriorated so much. At both these camps he found that the bulk of the power used was electrical. On his return to England on December 1st last, Captain Lotbinière received the tenders, and he has now returned to India, with the committee's report on each of the five schemes. All that now remains to be done to put the scheme into operation is to accept one of the five tenders, and within 20 months we shall have the installation set up and at work. Throughout Captain Lotbinière was in close communication with Sir K. Seshadri Iyer, K.C.S.I., the Dewan, and Colonel McNiel Campbell, R.E., the chief engineer of Mysore, so that whatever success may be achieved is largely due to these officers. Without their approval and assistance it would have been impossible to get the great scheme undertaken."

**Crewe.**—The Town Council has resolved to apply to the Local Government Board for leave to borrow £10,000 for extensions of the electric lighting mains.

**Deal.**—The Town Council has resolved not to entertain the lighting of the town by electricity for the present.

**Devonport.**—The Electric Lighting Committee has approved the plans, estimates, and specifications prepared by the electrical engineer for the erection and equipment of the power station at Newport Quay, and for mains and works in Devonport. The Local Government Board will be requested to sanction the borrowing of £74,536 in respect thereof.

**Dewsbury.**—The Lighting Committee of the Town Council has accepted the tender of Messrs. Bruce Peebles & Co. for a 110-KW. dynamo, with Willans engine, and has resolved to borrow £1,900 for electric lighting purposes.

**Exeter.**—A statement was laid before the Exeter City Council on Wednesday, last week, of the costs incurred by the Defence Committee in the action brought against the London Electric Supply Corporation in reference to the transformer patents. The cost of counsel, documents, &c., amounted to £4,548, and the solicitors' costs to £1,000. Calls had already been made on the contributors for £2,533, and the balance of £3,015 had to be raised, but the Committee hoped, when the plaintiff paid the taxed costs, to make a proportionate return to the subscribers. Exeter had paid £5 8s., and it was decided to pay the remainder of the city's share of the costs—£19 9s. 5d.

**Felling.**—The District Council, finding that the local electric power Bills are likely to become law, has decided to approach the companies and try to get favourable terms! As the Council previously opposed the Bills, this *volte-face* is not without its humorous aspect.

**Friern Barnet.**—The District Council has resolved to take the necessary steps to obtain a provisional order for the lighting of the district by electricity.

**Frome.**—The District Council is inquiring into the cost of electric lighting.

**Gravesend.**—The Town Council has appointed a committee to inquire into the question of electric lighting.

**Hanley.**—An assistant electrical engineer is wanted for the electricity works. See "Official Notices" to-day.

**Hyde.**—At a recent meeting of the Town Council it was stated that at a meeting of the representatives of Hyde, Stalybridge, Mossley, and Dukinfield, Mr. A. H. Gibbings, of Bradford, had been appointed engineer to report upon the feasibility and cost of a proposed joint scheme for providing electric traction and lighting for the four districts.

**Ilkeston.**—The Town Council has resolved that application be made to the Local Government Board for sanction to borrow £18,271, and to the Board of Trade for sanction to borrow £62,074 in connection with the electric lighting and tramway schemes.

**Italy.**—La Società Italiana di Elettrochemica Volta has secured a concession to utilise the water-power of the River Tirino, in the province of Aquila. It is stated that 9,000 H.P. will be available.

**Kilmarnock.**—The Lighting Committee of the Town Council has recommended the adoption of an electric lighting scheme at an estimated cost of £25,000. A motion to insert a "fair wages" clause in all contracts has been rejected by the Council.

**Leamington.**—The Town Council has resolved that if the suggested clauses and amendments filed by the Corporation be accepted by the Midland Electric Light and Power Company, Limited, and embodied in the order they are now applying for, the Corporation will abandon the order obtained by it in 1899, and withdraw its opposition to the company's order.

**Leeds.**—The City Council has resolved to oppose the electric power distribution Bills now before Parliament.

**Liverpool.**—The electric lighting accounts for the year 1899 show a net balance of £11,206 13s. 8d. The Committee proposed to transfer £6,000 to renewal account and the balance to reserve, but this was opposed in the Council meeting, and the question was deferred.

The Chamber of Commerce has given its support to the Lancashire Electric Power Bill.

**Walker.**—The District Council has adopted the report of the Electric Lighting Committee on the terms proposed by the Newcastle-upon-Tyne Electric Supply Company for the supply of electricity in the district; certain details remain to be settled, and the agreement will come up for confirmation later.

**Sheffield.**—At recent meetings of the Electric Light Committee of the Corporation, the changes necessary, consequent upon Mr. W. Johnson ceasing to be engineer and manager, have been considered. A report was to be presented to the Council on Wednesday, in which it was recommended that the management of the electric light and power undertaking should in future be divided into two departments, viz., Electrical and Commercial. The head of the former will be styled the Electrical Engineer, and of the latter the Commercial Manager, each to be directly responsible to the committee. The engineer will have

charge of the whole of the generating and distributing plant, and of the staff engaged in connection therewith, and will design and carry out all extensions and alterations of the same. The manager will deal with the books and accounts of the station, and of the distribution to consumers, the collection of revenue, the wiring and fitting departments, the purchase of machinery and stores, and the management of the necessary staff. All salaries, wages, and accounts will be paid by the city accountant. In addition to these officers, the committee recommends the appointment of a consulting engineer to advise the Corporation on the management and development of the undertaking, and on new machinery. It is recommended that Mr. H. S. R. Parton be appointed Commercial Manager at a salary of £300 per annum; that advertisements be issued for candidates for the position of Electrical Engineer, at a commencing salary of £500 per annum; that Mr. Robert Hammond be appointed consulting engineer at an annual fee of £105, to cover all advice by correspondence; Mr. Hammond to be paid for reporting on specifications and machinery, and other matters on which his services may be required, and for journeys according to time occupied.

**Stirling.**—The Lighting Committee of the Police Commission conceived the very happy idea of turning on the electric light for a trial during the "Relief of Ladysmith" celebrations on Thursday evening, March 1st, and thereby synchronised its inauguration with a historical event which will never be forgotten. The brilliance of the new light added greatly to the delight and comfort of the immense crowds which had turned out to witness the illuminations and fireworks.

**London.**—County Council.—The Highways Committee on Tuesday last reported that complaint had been made by the Vestry of St. George-the-Martyr, Southwark, of repeated failures in the supply of the electric light by the London Electric Supply Corporation. The Vestry had asked the Council to take proceedings against the company in respect of the failures, and had offered to render assistance if legal action was taken in the matter. Inquiries had been made, and the Committee expressed the opinion that, although there were several cases of failure of supply to certain premises in the parish, and that the Council should take proceedings for the protection of the public, it was desirable to rely only on three specific cases, as to two of which, namely, the St. George's Public Library in Borough Road, and the Council's Weights and Measures Office in Union Road, records of the failures had been kept, while in the other the proprietor of the premises was prepared to give evidence of failures of supply on the same dates as the failures at the public library. The company's order and the Board of Trade regulations provide for the imposition of penalties not exceeding, under the order 40s. a day, or under the regulations £5 a day, in case of defaults of supply; and, as the repeated interruptions of the company's supply had caused inconvenience to customers in that parish, the Council resolved on the recommendation of the Committee to authorise the solicitor to take proceedings against the company to recover penalties for default in the supply of electrical energy. The Council were informed by the Highways Committee last October that they had disapproved of certain works proposed to be carried out by the County of London and Brush Provincial Electric Lighting Company under the County of London (East) Order, 1897. The company appealed to the Board of Trade against the disapproval, and the appeal was heard on February 15th. The Highways Committee now reported that the Board of Trade had allowed the appeal of the company.

The Board of Trade has invited the various local authorities to send representatives to a conference, convened for the 8th prox., for the purpose of discussing the adjustment of the electric lighting areas rendered necessary by the coming changes in the boundaries of the new boroughs.

**Long Eaton.**—The District Council has appointed Messrs. Hopkinson & Talbot to report upon the electric lighting scheme.

**Maidstone.**—The District Council has decided to increase the proposed electric lighting area, and to borrow £40,000 instead of £30,000 for the purpose of carrying out the undertaking.

**Mexborough.**—The District Council is obtaining tenders for a destructor in connection with the electric lighting scheme, and is about to appoint a consulting engineer.

**Newport (Mon.).**—At the last meeting of the Electricity Committee of the Corporation the office manager reported that the total number of lights connected and on order was equivalent to 32,162 8 c.p. lamps. Letters having been read complaining of the vibration caused by the electricity works, the consulting engineer was instructed to report on the question of the future development of the works, having regard to such complaints.

**Otley.**—The District Council is inquiring into the advisability of lighting the town by electricity.

**Perth.**—The Police Commissioners have resolved to apply for a provisional order authorising them to borrow £100,000, half for gas and half for electric lighting purposes.

**River Shannon.**—At a meeting of the Limerick Corporation last week a report was read from Mr. Hassard, of London, the consulting engineer retained by the Corporation at the expense of the Electric Power Syndicate, on the plans of the promoters, with reference to their bearing on the Corporation waterworks and on the fishing industry. It was decided, and agreed to by the syndicate, that suitable clauses should be inserted in the Bill to safeguard the interests of the Corporation. The Limerick County Council has approved of the scheme. It is stated that the Irish Office is making inquiry into the object and scope of the Bill. The Limerick Board of Guardians and the Limerick District No. 2 (Clare) Council have unanimously adopted resolutions in favour of the scheme.

**Russia.**—The central station of the Société d'Eclairage Electrique de Saint Petersburg is now supplying current to an equivalent of 127,654 10-c.p. lamps, as compared with 54,164 a year ago.

**Sunderland.**—A curious accident occurred last week, when an electric lamp-post blew up! Fortunately, the inspection door in the base gave way, saving the post from serious damage. No doubt the explosion was due to an accumulation of gas getting into the pillar and, in some mysterious way, becoming ignited.

**Sutton Coldfield.**—The report of the Electric Lighting Committee, in which they recommended the lighting of the district with electricity, has been approved by the Town Council, which has decided to employ Mr. Hawtayne to carry out the scheme at a commission of 5 per cent., and to apply to the Local Government Board for sanction to borrow £26,000 for the work and an additional £10,000 for future extensions to Four Oaks or other portions of the borough.

**Trowbridge.**—The District Council has received a report from the surveyor, Mr. E. G. Bradshaw, on the subject of electric lighting, in which the cost of a generating station of 4,000 8-c.p. lamps capacity is put at £10,000 or £11,000. The Lighting Committee last week recommended that a provisional order be obtained for electric lighting. The Council agreed.

**Torquay.**—At a meeting of the Town Council last week it was reported that the Local Government Board had now given their sanction to the whole of the loan of £10,000 recently applied for, with the exception of £164 which was expended on works rendered useless by the change of the site of the central station, and £200 excess of expenditure over the estimate in the case of the rectifiers. The Electric Lighting Committee recommended that application be made for power to borrow a further sum of £10,000 for additional generating and other plant, and £5,000 for the extension of mains. A plan and estimate presented to the Committee by Mr. Storey, the engineer, showed that the cost of the additional plant at the central station would be about £9,848. In order to save time the Committee decided that specifications be prepared and tenders invited and accepted, subject to the sanction of the Local Government Board to the necessary loan. The works are to be carried out under the direction of Mr. Storey, who is to receive an honorarium of £250 on the completion of the work to the satisfaction of the Council. Alderman Kerswill, chairman of the Committee, explained that they commenced the undertaking two years ago with 55 private consumers and 3,200 8-c.p. lamps. Now they had 214 consumers and 11,326 8-c.p. lamps connected. As the total capacity of the present plant was 11,500 lamps, it was necessary to make additions to it. The undertaking, he added, was a great commercial success.

**Whitby.**—A Local Government Board inquiry will be held at Whitby to-day to consider the District Council's application for sanction to borrow £25,000 for electric lighting purposes.

**Wolverhampton.**—A Local Government Board inquiry into the application of the Town Council for leave to borrow £11,000 for electric lighting purposes is to be held to-day.

## ELECTRIC TRACTION NOTES.

**Barnsley.**—A Light Railways Commission inquiry was held last week into an application of the British Electric Traction Company for an extension of the system of light railways in Barnsley and the district. The proposed extension is about half a mile. Mr. S. Sellon, engineer, gave evidence as to the practicability of the proposed extension. The roads along which it was to be carried varied from 18 feet 4 inches to 22 feet in width, and the heaviest gradient was 1 in 13—practical working gradients for electric traction. Power would be obtained from the Barnsley Corporation electric lighting station. The cost would be £3,615 14s.; and the period of purchase 28 years. Waiting rooms would be provided, and the line constructed within two years. On the suggestion of Mr. W. C. Williams, of Barnsley, it was stated that the clause empowering purchase by consent at any time was incorporated in the order, and the Commissioners said they would have pleasure in recommending the order asked for.

**Bolton.**—During February 728,024 passengers were carried, the revenue totalling £3,033 8s. 8d. The average number of cars in use was 28 and the miles travelled 64,302. The members of the Council viewed the trial of a new bogie car last week.

**Central London Railway.**—The Central London Railway Company has presented a petition to the House of Commons praying for leave to deposit a Bill this session, although the time for doing so has long since expired. The Committee on Standing Orders having considered the petition has given leave to the company to deposit its Bill, which will in due course be further considered by the Standing Orders Committee of the House of Lords.

**Cheltenham.**—The Lighting Committee is to meet the promoters of the electric tramway to Cleeve Hill to discuss charges for supplying current from the Corporation electricity works for working the cars.

**Cheshire.**—On Monday last week a conference of the Winnington, Anderton, Barnton, and Little Leigh Parish Councils and the engineer of the Warrington-Northwich light railway was held at Winnington. As a result the engineer agreed to immediately proceed with the westerly extension of railway, to include the important townships of Whiteley, Little Leigh, Barnton, and Winnington. On this line workmen's trains would be run at a ½d. per mile. A supplementary scheme was also submitted to connect Winnington with the Chester Road, and the engineer promised to give this favourable consideration, and also to introduce an improved conduit system for town traffic.

**Dublin and Lucan.**—On 8th inst. the Dublin and Lucan Tramway was opened for traffic by electric traction. The six cars at present available for use, are mounted on Brill patent bogies. The system is worked by overhead trolley. The power station, which is now complete, with all the plant laid down, is located at Fonthill, about 5½ miles from Dublin, on the city side of Ballydowd Hill. It contains two high speed, compound, horizontal engines of 200 H.P. each, coupled direct to the generators, and working at a speed of 260 revolutions per minute. The engines were manufactured by the Ball & Wood Company, of New York. The boilers, two in number, are of the Lancashire type, and were made by Galloways. Green's economisers also form part of the equipment of the boiler house. Special pump motors and machinery have been laid down in the pump house on the bank of the River Liffey, 600 yards from the power station, and are run with a special line of wire from it. This arrangement was found necessary, as water had to be pumped from such a distance and height, the drop from the level of the power station to the river level being about 160 feet.

**Dudley.**—At the meeting of the Town Council last week, complaints were made by several members of excessive speed, unpunctuality, and overcrowding on the electric tramways. Alderman Dunn, in reply, explained that the old bye-laws were not applicable to the new company; and reminded the Council that it was in the power of the Watch Committee to deal with cases of excessive speed.

**Dudley and Stourbridge.**—A collision which caused injuries to three persons occurred on Monday morning on the Dudley and Stourbridge electric tramway.

**Exeter.**—The question of the purchase of the horse tramways in the city and their extension on the overhead electric traction system was again mentioned at the meeting of the City Council last week. Messrs. F. Burt & Co. had written to the Council inquiring what prospect there was of the Council carrying out their proposal to acquire the undertaking of the Exeter Tramways Syndicate. It was decided to reply that nothing could be done in the matter until the question of the extension of the city boundaries, which is the subject of a Bill before Parliament, is decided.

**Mersey Railway.**—On 9th inst. the Mersey Railway Company held a special meeting in London, and approved the Bill now pending in Parliament.

**Newcastle-on-Tyne.**—The *Practical Engineer's* New York correspondent says that Mr. Le Rossignol, resident engineer of the Corporation tramways of Newcastle-on-Tyne, has just spent about four weeks in the United States inspecting some of the larger power stations there.

**Newport (Mon.).**—The Lighting and Traffic Committee recommends that the construction of the Corporation Road tramway station be proceeded with this spring, that the work be carried out by the Committee, employing direct labour, that the lines be laid 3 feet apart, and the span-wire system adopted for electric traction.

**Paisley.**—In view of the withdrawal of the proposals of the British Electric Traction Company, a special meeting of the Town Council was held last week at which it was resolved also to drop all further negotiations with the Glasgow District Tramways Company in the meantime, with a view to the Council going in for a similar Bill to that of the Glasgow District Tramways Company in the next session of Parliament. The proposed Bill, it is understood, will include tramways throughout the burgh and connecting Johnstone and Renfrew.

**Prizes Offered.**—In connection with the International Tramways and Light Railways Exhibition (June 23rd to July 4th, 1900), the promoters have decided, at the suggestion of several tramway managers, to offer the following prizes to exhibitors:—

(1) A prize of £25 for the best invention for securing a dry seat on the tops of tramcars and omnibuses in all conditions of weather.
(2) A prize of £25 for the most practical and efficient life-saving guard or fender for tramcars.

Particulars as to conditions can be obtained at Amberley House, Norfolk Street, W.C.

**Stirling.**—The negotiations between the Police Commissioners and the British Electric Traction Company in connection with the transfer of the Stirling and Bridge of Allan tramways are now proceeding smoothly. The Commissioners are willing to forego their right of pre-emption which accrues next year, on condition of a payment to them of £750 on the completion of the agreement, while in addition the Traction Company are to contribute the sum of £650 towards the cost of a new road on the way to Bannockburn. The Traction Company are also to pay to the Commissioners £125 per mile per annum for wayleave, street maintenance and repair, while they come under an obligation to take the electric current for working the cars from the Commissioners. The Commissioners will have the right of purchase of the line at the end of 35 years from 1902.

**West Hartlepool.**—After some years of conflict, a good understanding seems to have been arrived at between the Electric Tramway Company and the Corporation of West Hartlepool. A commencement has been made with the new line to Seaton Carew, and when this is finished the electric power will be drawn from the Corporation's works. For this year the Hart Road and Park Road extensions have been dropped.

**Wolverhampton.**—The Tramway Committee of the Town Council have now come to an arrangement with the Dudley and Wolverhampton Tramways Company, Limited, for the purchase of so much of the company's undertaking as lies within the borough. The valuation amounts to £4,250, which includes the value of the line, rolling stock, engineering expenses on construction, Parliamentary charges, &c. The length of the line acquired is 1 mile 253 yards.

## TELEGRAPH AND TELEPHONE NOTES.

**Anglo-French Telegraphs.**—The Reuter's Paris correspondent says that a Bill was distributed on 12th inst., approving the telegraphic convention signed at Paris on February 17th, between Great Britain and France.

**Buenos Ayres Telegraphs.**—The Telegraph Department of the province of Buenos Ayres has published its report for 1899, an abstract of which is given in the *Review of the River Plate*. The length of the lines was 4,771 kilometres, and the total length of wires 6,941 kilometres, valued at $1,366,350 m/n. There were 104 offices, of which 76 worked till 8 p.m., 25 till midnight, and 3 day and night. The instruments comprised 163 Morse, 23 translating, and 58 commutators, making a total of 244. The employé numbered 479. The total working expenses amounted to $594 380 m/n, and the number of telegrams to 1,412,991. The revenue amounted to $505,787.83, a decrease of $38,705 when compared with 1898, but this is principally due to the decrease in official messages, $35,762. Public telegrams show an increase of $4,000.

**Censorship on Telegrams at Aden.**—The Postmaster-General has written to the Association of Chambers of Commerce that:—

The Government have decided to relax the censorship on telegrams at Aden to the extent that telegrams to or from Zanzibar, Seychelles, Mauritius, Madagascar, British East Africa, German East Africa, Mozambique, and Lorenzo Marques, relating to commercial or private affairs, may be sent in code language at the sender's risk, on condition that copies of the code used, with translations of the code words, are previously deposited with the authorities at Aden. Two independent codes will be accepted in respect of each country, and it will be necessary for the mercantile community of this country, if they desire to avail themselves of the concession, to agree as to the codes which should be selected for the United Kingdom, and to furnish a translation of the codes in English. The Postmaster-General will be glad if the Association will consult the Chambers of Commerce on the subject and favour him with an early reply.

**Indo-European Telegraph Company.**—The *Financial Times* says that according to the Russian Telegraph Agency, the official *Regierungsbote* announces that the concession of the Indo-European Telegraph Company, which expires on January 31st, 1905, has been extended for a period of 20 years. In return for this privilege the company has undertaken to pay to the Russian Government 17½ per cent. of the receipts, instead of 10 per cent. as hitherto, on Indian telegrams and telegrams beyond India which are exclusively dispatched by the line worked by the company. The company has also agreed in case of political complications arising, to place at the full disposal of the Russian Government all its lines situated on Russian territory at the first request made by the authorities.

**Manchester Telephones.**—At last week's Council meeting Mr. Plummer referred to a resolution passed by the special committee dealing with the telephones, providing that, with a view to the municipalisation of the telephone service, the National Telephone Company should be approached in order that it might be ascertained whether the undertaking of the company in the Manchester area could be purchased by the Corporation. He desired to know whether the adoption of the resolution would finally put out of court the application of the Mutual Telephone Company to the Corporation to grant them a license. The town clerk said that it was difficult to see how the resolution could be carried out consistently with the granting of the license to the company. After some remarks by Mr. Brocklehurst, Sir John Harwood, Mr. Shann, and some other members of the Council, in which it was explained that the proceedings of the committee might be approved without prejudice to the future consideration by the Council of the position of the Mutual Company, Mr. Plummer said that assurance would be satisfactory to him, and the proceedings were adopted.

**The New Cable to South Africa.**—In the House of Commons on 12th inst. Sir Charles Dilke asked the Chancellor of the Exchequer whether steps had been taken to secure the possibility of messages to Cape Town by the new cable of the Eastern Telegraph Company, in respect of which a payment of £10,000 had been made in the present financial year, being sent without passing through any foreign stations; or whether it was contemplated that all messages shall continue to pass through a Portuguese station. The Chancellor of the Exchequer replied: The payment of £10,000 was made merely to secure the opening of the cable between Cape Town, St.

that suitable clauses should be inserted in the Bill to safeguard the

the Standing Orders Committee of the House of Lords.



Helena, and Ascension at the earliest possible date, and had no reference to the matter alluded to in the question. The cable will, I believe, be extended to St. Vincent, through which, as now, messages will pass.

**New Channel Cable.**—The laying of a new submarine cable across the English Channel to Beachy Head was commenced on Monday at Cape de la Hève, near Havre, by the English cable steamer *Britannia*.

**The Pacific Cable Scheme.**—In the House of Commons on Tuesday Sir E. Sassoon asked the Secretary of State for the Colonies whether he was aware that the rights now on the point of being ceded to the Eastern Extension Telegraph Company by the Australian Governments materially altered and affected the conditions upon which the Pacific cable scheme, to which these Governments were signatories, had been based; and that the Canadian Government regarded these concessions as likely to defeat and probably to lead to the abandonment of the enterprise. Mr. Chamberlain, in reply, said: The question how the proposed concession to the Eastern Extension Telegraph Company of the right to open its own offices in the Australian capitals when the Pacific cable has been laid will affect that scheme, has been referred to the Pacific Cable Committee for consideration and report. The hon. member will see from the correspondence recently laid before the House that Her Majesty's Government have stated that the question of these concessions is one for the Colonial Governments concerned, but they have asked the Governments of New South Wales and Victoria to defer concluding any agreement with the company until the Cable Committee has reported on the question.

The British Empire League at Ottawa, on Wednesday, passed resolutions urging the speedy completion of the State-owned Pacific cable. Mr. Mulock said if anything now blocked the scheme it would be a national calamity.

**Telegraphic Interruptions and Repairs:—**

| Cables. | Down. | Repaired. |
|---|---|---|
| West Indies:— | | |
| Jamaica-Colon ... ... ... | June 30, 1899 ... | ... |
| Trinidad-Demerara (1891 duplicate) ... ... ... ... | Oct. 23, 1899 ... | ... |
| Mole St. Nicholas-Cape Haitien... | March 6, 1900 ... | ... |
| New York-Hayti ... ... ... | Feb. 26, 1900 ... | ... |
| Anier-Halinda ... ... ... | March 9, 1900 ... | March 12, 1900 |
| Cayenne-Pinheiro ... ... ... | Oct. 11, 1899 ... | ... |
| Cayenne-Paramaribo ... ... | Feb. 16, 1900 ... | ... |
| Ceara-Maraham ... ... ... | Feb. 20, 1900 ... | ... |
| Para-Maraham ... ... ... | March 2, 1900 ... | ... |
| Djedda-Souakim ... ... ... | March 13, 1900 ... | ... |
| Hong Kong-Macao ... ... ... | March 6, 1900 ... | March 11, 1900 |
| Latakia-Cyprus ... ... ... | June 20, 1899 ... | ... |
| Tarifa-Tangier ... ... ... | Jan. 2, 1900 ... | ... |
| **Landlines.** | | |
| West Indies:— | | |
| Communication with Port de Paix (Haiti) ... ... ... ... | Feb. 26, 1900 ... | ... |
| South African:— | | |
| Communication with Mafeking and beyond ... ... ... | Oct. 13, 1899 ... | ... |
| Communication with all offices beyond Orange River ... ... | Oct. 18, 1899 ... | ... |
| Communication with north of Mooi River (Natal) ... ... | Oct. 22, 1899 ... | ... |
| Communication beyond Burghersdorp (Cape of Good Hope) ... | Nov. 7, 1899 ... | ... |
| Communication beyond Estcourt (Natal) ... ... ... ... | Nov. 7, 1899 ... | ... |
| Communication with Bluefields (Nicaragua) ... ... ... | July 7, 1899 ... | ... |
| Communication with all offices of Colombia ... ... ... ... | Oct. 23, 1899 ... | ... |
| Communication with Colombia beyond Buenaventura ... ... | Jan. 22, 1900 ... | ... |
| Communication "*vid* Hanekine" interrupted on Persian Territory | Feb. 24, 1900 ... | ... |
| Fusan-Seoul Chemulpo ... ... | Mar. 12, 1900 | Mar. 12, 1900 |
| Serena-Valparaiso ... ... ... | Jan. 16, 1900 ... | ... |

**The Telegraphic Wire Export Trade.**—An unusually active state of affairs prevailed in the export trade of this country in telegraphic wire and apparatus connected therewith during February last, the value of the shipments for the month, according to returns just issued, amounting to no less than £502,816, a total which compares with only £46,964 in the preceding month, and £59,424 in February, 1899. For the two months the returns show an aggregate of £556,879, as against only £370,890 in the first two months of last year, and £113,205 in the corresponding period of 1898.

**Telephone Licenses.**—On Tuesday, in the House of Commons, Mr. Crilly asked the Secretary to the Treasury, as representing the Postmaster-General, whether any licenses to form public telephone exchanges under the Act of last session had been applied for to the Post Office; if so, how many; and how many such licenses had been granted; how many of them had been granted to public corporations and how many to incorporated companies; how many such licenses were in force in opposition to the existing licenses held by the National Telephone Company; and in what districts were such competing licenses operating. Mr. Hanbury replied, according to the *Times* report: Three actual applications for licenses for telephone business have been made by local authorities. In one case a license had been granted—namely, to the Corporation of Glasgow, for an area co-extensive with the Glasgow area of the National Telephone Company. The Postmaster-General had also been in correspondence with 22 other local authorities, who are considering whether they shall apply for licenses. Two applications for licenses have been made by companies. A license has been granted to the Mutual Telephone Company of Manchester for the borough of Salford and certain adjacent urban districts. The other application has been referred for approval to the Corporation concerned, in accordance with Section 3 of the Telegraph Act, 1899. There is, of course, a telephone system worked by the local authority in the Island of Guernsey.

**Turkish Telegraphs.**—A Reuter despatch from Constantinople says that the German Embassy has made renewed representations to the Porte for a concession to lay a cable between Constanza and Constantinople. Owing to a protest from the Eastern Telegraph Company, supported by the British Embassy, the question has remained in suspense for a year, because the granting of the concession to Germany infringes the privileges enjoyed by the Eastern Telegraph Company, which possesses preferential rights to lay cables in the Ottoman Empire.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Belgium.** — March 28th. Tenders are being invited until 28th inst., by La Société Nationale des Cheminsde Fer Vicenaux of Brussels, for the supply of a battery of accumulators for use in connection with a system of light electric railways in the Liège district. Tenders to be sent to the company, 26, Rue de la Science, Brussels, whence particulars may be obtained.

**Birkenhead.** — March 20th. The Corporation wants tenders for the supply and erection of overhead tramway equipment. See "Official Notices" March 9th.

**Blackpool.**—March 27th. The Tramways Committee wants tenders for 15 electric tramway cars. See "Official Notices" to-day.

**Cardiff.**—April 3rd. The Corporation wants tenders for the wiring and fitting up for electric light the new Fish Market in the Hayes, Cardiff. Particulars, &c., from the electrical engineer, Eldon Road, Cardiff, deposit one guinea.

**Crete.**—April 7th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Canea, Crete, stating that tenders are invited by the Cretan Government, not later than April 7th, for the construction and working of tramway lines between Canea and the suburb of Halepa, and between Canea and the new Government offices. Such particulars as have been received may be examined on personal application at the Commercial Department on the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

**Dartford.**—March 27th. The Urban District Council is inviting tenders for the supply of Lancashire boilers, pipework, surface condenser, two high speed steam dynamos and motor boosters, batteries, switchboard, overhead traveller, mains, conduits and roadwork, arc lamps and posts, and station lighting. See "Official Notices" March 2nd.

**Doncaster.** — March 28th. The Corporation Market Committee is open to receive tenders for lighting the Corn Exchange by electricity. Specification, &c., from the Resident Electrical Engineer, 3, Priory Place.

**Dublin.**—April 26th. The Electric Lighting Committee wants tenders for six Lancashire and four water-tube boilers and two economisers; two 1,000-KW. and two 500-KW. low speed polyphase generators for the electricity supply scheme. See "Official Notices" March 9th.

**Dundee.**—March 21st. The Town Council wants tenders for feeder mains, joint boxes, and underground conduits for tramway purposes. See "Official Notices" March 9th.

**Durban (Natal).**—April 2nd. The Corporation is inviting tenders for 1,900 tons of steel girder rails, 64 tons of fishplates (bolts, bonds, &c.), 407 loads Australian hardwood stringers, &c., also the laying of same for 14·36 miles of single track, and bonding 2·96 miles of equivalent existing single track, the Corporation laying concrete foundations and making up roadway. See "Official Notices" February 9th.

**Fulham.**—March 19th. The Vestry wants tenders for 100 5-ampere meters, 100 10-ampere meters, and 50 20-ampere meters. See "Official Notices" March 9th.

**Halifax.** — April 7th. Tenders are being invited for electric lighting work for the Victoria Concert Hall and premises. See "Official Notices" to-day.

**Hull.**—March 22nd. The Electric Lighting Committee wants tenders for two steel Lancashire boilers. See "Official Notices" March 9th.

**Keighley.**—March 31st. The Corporation wants tenders for wiring the new municipal offices now erecting. See "Official Notices" to-day.

**Lancaster.**—March 22nd. Tenders are wanted for three Lancashire boilers, superheaters, economiser; three 175-B.H.P. steam dynamos, booster, switchboard, pumps, cranes, &c.; accumulators;

mile per annum for wayleave, street maintenance and repair, while

merely to secure the opening of the cable between Cape Town, St.



feeder mains (solid system); and wiring of buildings, all for electric lighting purposes at the Rainhill County Asylum. Particulars will be found among our "Official Notices" February 23rd.

**Leeds.**—March 21st. The Tramways Committee wants tenders for one, two, or three steam dynamos. See "Official Notices" February 23rd.

**Maidstone.**—April 3rd. The Corporation wants tenders for steam and water pipes and valves for electric lighting works. See "Official Notices" to-day.

**Plymouth.**—March 21st. Tenders are invited for wiring the Municipal Offices, and for 12 months supply of lubricating oils for the electricity works. Specifications for each item may be obtained from Mr. Rider, the engineer, for a deposit of 10s. 6d. each.

**Plymouth.**—March 22nd. The Electricity Works require tenders for 12 months' supply of alternating current meters and transformers and arc lamp carbons. See "Official Notices" March 9th.

**Southampton.**—March 16th. The Corporation invites tenders for the supply of stores, &c., required in the Electricity Department during a period of 12 months, according to specification and conditions to be obtained upon application at the Electric Light Works, Back-of-the-Walls.

**Southampton.**—April 7th. The Harbour Board invites tenders for a motor transformer with accessories. See "Official Notices" to-day.

**St. Anne's-on-the-Sea.**—March 23rd. The Council wants free wiring proposals. See "Official Notices" to-day.

**Sunderland.**—March 20th. The Corporation wants tenders for india-rubber covered cables, wrought-iron and cast-iron piping, and box frames, and covers, for the electricity undertaking. See "Official Notices" to-day.

**Swansea.**—March 19th. The Corporation invites tenders for insulated electric mains, conduits, junction boxes, &c., for electricity supply. See "Official Notices" March 2nd.

**Walthamstow.**—March 23rd. The Council wants tenders for the supply and laying of electric lighting cables. See "Official Notices" March 9th.

### CLOSED.

**Derby.**—The Council has placed an order for a 100-H.P. surface condenser for the electric light works with Messrs. Browett, Lindley & Co., at £705.

**Dudley.**—The contract for certain pipe work, pumps and feed water heaters for the electricity works has been placed with Babcock & Wilcox.

**Glasgow.**—The Tramways Committee of the Corporation have accepted the tender by Messrs. M'Cartney, M'Elroy & Co., for the construction of the overhead portion of the extension of the electric tramways, which has been sanctioned by the Town Council. The contract price is £47,483, and it includes the providing and fitting up of the poles, wires, and rosettes. The committee have accepted the following tenders by Glasgow firms for the remainder of the underground work which requires to be done to complete the conversion of the tramway lines:—Messrs. Daniel Murray, £18,563; Stark & Sons, £12,851; A. & J. Faill, £9,463; and James Cameron, £4,688. All the contracts are to be completed within a year.

**Leyton.**—The District Council has accepted the tender of Bertram Thomas, of Manchester, for a switchboard, for the sum of £848.

**Rotherham.**—The Town Council has accepted the tender of the Electrical Power Storage Company for accumulators at £812 10s., and £70 per annum for maintenance.

**St. Anne's.**—The following tenders have been accepted by the Town Council:—Messrs. McCullock for 100 lamp-posts; the Prism Globe Company for 100 fittings; and the Reason Manufacturing Company for 100 switches with sockets.

## FORTHCOMING EVENTS.

Saturday, March 17th.—At 11.30 a.m. Institution of Electrical Engineers. Students' Visit to the works of the Electric Welding Company, 21, Hindon Street, Pimlico, S.W.

At 8 p.m.—Morley College Faraday Society, Waterloo Road, S.E. Presidential address by Prof. Carey Foster, F.R.S., on "The Modern Point of View of Electrical Phenomena." Readers will be admitted by ticket to be had at the doors of the college on the evening, or previously by application to the Secretary, Morley College.

At 7.30 p.m.—Manchester Society of Electrical Engineers. Meeting at the Engineering Laboratories, Whitworth Street, Manchester. Paper on "Electricity as Applied to Mining," by Mr. H. Bentham; will be read by the President, W. W. Haldane Gee, B.Sc.

At 3 o'clock.—Royal Institution of Great Britain. Lord Rayleigh on "Polarised Light."

Monday, March 19th.—Society of Arts. Third Cantor lecture. E. S. Shepherd on "The Photography of Colour."

Tuesday, March 20th.—At 4.30 p.m. Society of Arts (Foreign and Colonial Section). Sir Edward A. Sassoon, Bart., M.P., "Imperial Telegraph Communication."

Wednesday, March 21st.—At 7 p.m. Institution of Civil Engineers. Annual Dinner, Merchant Taylor's Hall, Threadneedle Street.

Thursday, March 22nd.—At 8 p.m. Institution of Mechanical Engineers. Ordinary meeting.

At 8 p.m.—Institution of Electrical Engineers. Ordinary meeting. Paper on "Storage Battery Problems," by E. J. Wade, Associate.

Friday, March 23rd.—At 5 p.m. Physical Society. Agenda:—1. "An Electro-magnetic Experiment," by Prof. S. P. Thompson, F.R.S.; 2. "Some Experiments illustrating Syntony," by Mr. P. E. Shaw; 3. "An Electrical Micrometer," by Mr. P. E. Shaw.

At 9 o'clock.—Royal Institution of Great Britain. Sir Andrew Noble on "Some Modern Explosives."

Saturday, March 24th.—The Manchester Association of Engineers. Paper by Mr. W. Heap, Manchester, "The Tool Room. (*a*) For the Manufacturer; (*b*) for the Engineer."

At 11 a.m.—Institution of Electrical Engineers. Students' visit to the works of Messrs. Easton, Anderson and Goolden, Limited.

Monday, April 23rd.—At 8 o'clock. Institution of Civil Engineers. The eighth "James Forrest" lecture, by Sir William Preece, K.C.B., on "The Application of Electricity to Engineering."

## NOTES.

**Obituary.**—We much regret to have to record the death, at the age of 53, of Mr. Matthew Cooper, Principal Technical Officer, Engineer-in-Chief's Office, General Post Office. The deceased gentleman (who was found dead in a train at Finsbury Park Station on Thursday morning, March 8th) was well known in electrical circles. Originally in the service of the Electrical and International Telegraph Company, prior to the transfer of the telegraphs of the United Kingdom to the State, Mr. Cooper was afterwards attached to the Special Rating Staff, under Mr. R. W. Johnstone. It was his particular duty in those days to attend at Sandringham, when the Prince of Wales was in residence, to work the private wire in communication with London, a position of great trust. For the last 20 years Mr. Cooper had done important work in the Engineer-in-Chief's office. He had witnessed the introduction of the duplex, quadruplex, and multiplex systems, and his skill as a mechanician combined with his thorough practical knowledge was very largely instrumental in making these systems the success which they are at present, for the climatic conditions in this country are such as to render the good working of these systems by no means the easy matter which might be imagined. For some time past Mr. Cooper had been in full charge of the Telephone Department of the Post Office, and he was recently engaged in drawing up the necessary arrangements in connection with the proposed London telephone system of the Post Office. One of Mr. Cooper's most onerous tasks was the working out of the apparatus details necessary to enable inter-communication to be effected between the various local systems of the National Telephone Company and the trunk wire system of the Post Office. This he effected with remarkable skill; indeed, it is not too much to say that the fact that the transfer was carried through almost unnoticed was largely due to the excellence of the arrangements which Mr. Cooper had personally to supervise. Not only has the Department lost a valuable servant, but his colleagues, with whom Matthew Cooper has for many years been associated, have lost an honoured and esteemed friend. The funeral which took place on Tuesday at Bell's Hill Cemetery, High Barnet, was largely attended by members of the Postal Telegraph Department and of electrical firms.

**Appointments Vacant.**—The Sheffield Electric Lighting Committee is advertising for an electrical engineer at £500 a year. The Glasgow Corporation wants an assistant manager for the municipal telephone exchange. Minimum salary £200 per annum. See "Official Notices" to-day.

**Receiver Appointed.**—The debenture holders in Fowler, Lancaster & Co. have appointed a receiver on their behalf with a view to giving time for completing certain negotiations which it is hoped will result in the payment of creditors.

license had been granted—namely, to the Corporation of Glasgow, dynamos, booster, switchboard, pumps, cranes, &c.; accumulators;



**The Will of Prof. Hughes.**—By the will of the late Prof. D. E. Hughes, F.R.S., who died on January 22nd last, London hospitals will benefit very considerably, for, subject to certain annuities to Mrs. Hughes and his sister and brother-in-law, the sum at present available for the "Hughes Hospital Fund" seems likely to be between £300,000 and £350,000, and eventually over £400,000. The whole of the estate has been valued at £473,034 9s. 3d. gross, including personalty of the net value of £472,704 15s. 6d. To Mrs. Hughes he bequeathed £20,000, his personal effects, his medals, books, instruments, and decorations, and scientific papers, and his bonds, shares, stocks, and securities for money deposited with the Société Générale de Credit Industriel et Commercial, compte 843, Rue de la Victoire, No. 66, Paris. Prof. Hughes bequeathed to his sister, Mrs. Margaret Hughes Millar, of Wyoming, U.S., £6,000; to her husband, Robert S. Millar, £4,000; and to their children, Katy Burrows, Daisy Millar, Edward Millar, Graham Millar, and Lily Hughes Lucas, £4,000 each. He bequeathed to the Institution of Electrical Engineers, of which he was Past-President, £2,000 for a David Hughes Scholarship Fund, similar to the Sir David Salomons Scholarship Fund; to the Société Internationale des Electriciens in Paris, of which he was a member, £2,000 for a Scholarship Fund; to the Royal Society, of which he was a Fellow, £4,000, to apply the income in prizes for original discovery in physical sciences, particularly in electricity and magnetism; to the Académie des Sciences de l'Institut, Rue Pont des Arts, Paris, £4,000, for like purposes; and to the Royal Institution of Great Britain, in Albemarle Street, £1,000, for its general purposes. The testator directed that his entire residuary personal estate should consist of a trust fund, to be called the "David E. Hughes Hospital Trust Fund," of which the first trustees shall be the treasurers of the Middlesex Hospital, the London Hospital, King's College Hospital, and Charing Cross Hospital. They will pay among other sums an annuity of £1,000 to Mrs. Hughes during her widowhood.

**Mishap on the City and South London Railway.**—On Tuesday, the 8th inst., a series of mishaps occurred on the City and South London Railway, which caused a total stoppage on the entire line for two hours and a half, from 7 p.m. to 9.30 p.m. The affair started in a slight way with an ordinary short on a locomotive on the line. This caused one of the automatic circuit breakers to "go," but not completely, and it was burnt out. A machine was consequently shut down. It was not at first possible to ascertain exactly where the short had occurred, some time being necessarily occupied in telegraphing down the line to the different stations, testing cables, and so on, and, unfortunately, before this could be put right an armature of one of the generators in the old station developed an earth. The coincidence of these two accidents led, as we have stated, to the shutting down of the line, and naturally caused Mr. McMahon and his staff considerable anxiety until all was right again.

**Lectures.**—Before the Aberdeen Mechanical Society on 6th inst., a lecture on "Electric Waves" was delivered by Prof. Niven.

At the Yorkshire College Engineering Society on February 26th, Mr. J. H. Greaves, Vice-president of the Derbyshire Engineering Association, read a paper on "The Mechanical Treatment of Coal and its Influence on the Construction of Modern Boiler Houses."

A course of four lectures is being delivered at the Bradford Technical College by Prof. Oliver Lodge on the subject of "Electrical Vibrations."

At the meeting of the Bath Debating Society on Thursday last week, Mr. George A. Pearson gave a lecture entitled "How to Make the Electric Lighting Pay." A discussion followed.

A lecture on "Electricity our Servant" was delivered by Mr. H. Bottomley Knowles at the G.W.R. Mechanics Institution at Swindon on Wednesday last week.

**Bankruptcy Proceedings.**—At the London Bankruptcy Court yesterday, Thursday, Mr. Registrar Hope made an order that the discharge of E. L. Joseph, electrical engineer, should be suspended for three years.

**Electrical Communication with Lighthouses.**—A meeting of the committee appointed to consider the question of the extension of the system of electrical communication with lighthouses and light-vessels, and the possibility of using such communication for the transmission of private messages, was held at the Board of Trade on Wednesday. There were present: Sir Courtenay Boyle (chairman), Captain Prince Louis of Battenberg, R.N., Mr. G. E. Y. Gleadowe, Mr. J. C. Lamb, Rear-Admiral H. B. Stewart, Captain the Hon. F. C. P. Vereker, R.N., and Mr. C. G. Moggridge (secretary). Mr. E. McArthur, M.P., Colonel Hozier, C.B., and Mr. A. L. Jones attended on the invitation of the committee, and stated their views on the question of the employment of the system of electrical communication with certain lighthouses for commercial purposes.

**The Electrical Volunteers.**—On Monday, March 5th, the South African detachment were entertained to a "send-off" dinner at the Shire Hall, Chelmsford, the Mayor occupying the chair. Major Rasch, M.P., responded on behalf of the Army, and Major Coleman for the Auxiliary Forces. Major Crompton and Captain Lloyd replied on behalf of "Our Guests." The proceedings were of a very enthusiastic character.

**Building Trades' Gift.**—The following valuable accessions to the list of donations are acknowledged with thanks:—

Messrs. Dorman & Smith, Manchester, main switchboard.
Messrs. Ward & Goldstone, Manchester, all the flexible cord required.
Messrs. McGeoch & Co., Birmingham, 426 5-ampere switches and accessories.

In our next issue we hope to give views of the elevation and plans of the Cottage Homes, showing the proposed arrangement of the buildings.

**Wireless Telegraphy.**—Mr. Marconi has been experimenting with his system before the King of Belgium and other members of the Royal Family.

**The Société Internationale des Electriciens.**—The monthly meeting of the Société des Electriciens took place on the 7th inst. M. Zetter continued the discussion commenced recently by M. X. Gosselin relating to high tension apparatus. He exhibited double-pole circuit breakers for 220 and 440 volts with distances between the terminals of 2·5 centimetres for 3 amperes, 3 centimetres for 5 amperes, 3·5 centimetres for 15 amperes. In switches he observed that a distance of 3 centimetres between two terminals was necessary in order to get a good break. M. X. Gosselin then made some observations with regard to the electrical tramway of the Bois de Boulogne, the mode of operation of which was a combination of the trolley system and surface contact on Vedovelli's system.

**Electric Tramway Currents and Submarine Cables.**—The *Daily Telegraph* correspondent at Cape Town says that on Tuesday the Supreme Court gave its decision in the suit of the Eastern Telegraph Company against the Cape Town Electric Tramways Company, in which the plaintiffs sought to recover £50,000 damages for alleged injury to their business through the escape of currents from the electric trams. The Court was unanimous in favour of the defendants. It will be remembered that a volume of evidence was taken on commission in London recently.

**Personal.**—Our New York namesake says that Mr. J. G. White, a well-known electrical engineer, sailed for England on 28th ult., where he has extensive engineering projects under way.

**London County Council.**—The Council at the meeting on Tuesday proceeded to the appointment of Committees for the ensuing year. The Highways Committee, to whom most, if not all, electrical matters are referred, was elected as follows:—

J. A. Baker, R. M. Beachcroft, J. W. Benn, J. R. Cousins, W. Haydon, L. H. Hayter, N. W. Hubbard, Sir John Hutton, W. C. Johnson, R. Parker, R. C. Phillimore, P. J. Rutland, T. B. Westacott, T. Wiles, and T. McKinnon Wood.

Monday, March 19th,—Society of Arts. Third Cantor lecture. E. S. Shepherd on "The Photography of Colour."

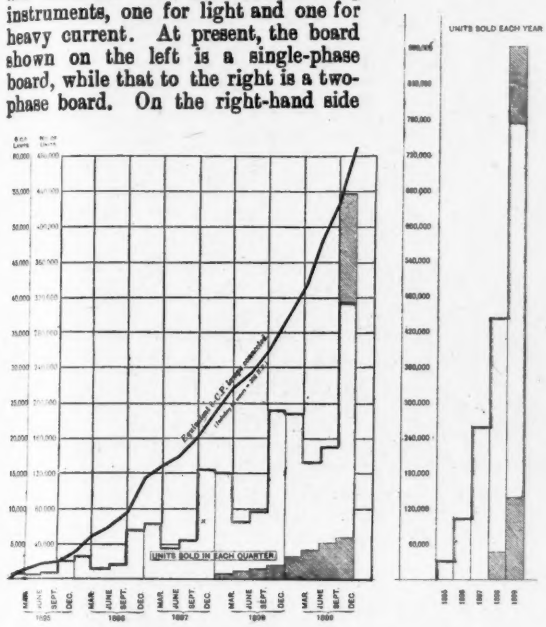
with a view to giving time for completing certain negotiations which it is hoped will result in the payment of creditors.



## THE COUNTY OF LONDON ELECTRIC LIGHTING COMPANY'S ELECTRICITY WORKS.

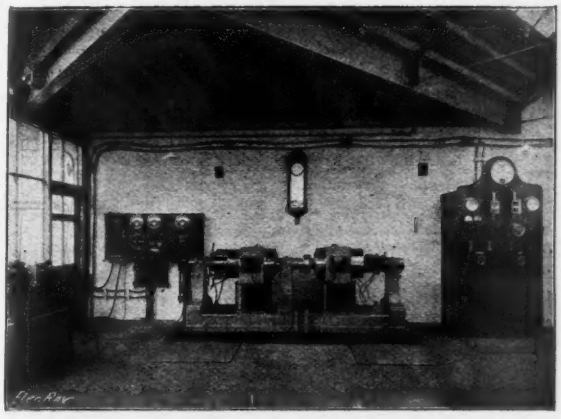
(*Concluded from page* 405.)

In our view of the Ferranti alternate current switch gear (pages 403-4) are shown the main alternator switchboards, each consisting of 12 switch panels, and between them the main measuring board, upon which are mounted two sets of measuring instruments, one for light and one for heavy current. At present, the board shown on the left is a single-phase board, while that to the right is a two-phase board. On the right-hand side of the dividing board there are at present placed two instruments for recording the output of each phase of the two-phase plant, while on the other side are two sets of instruments for measuring and recording the output of the heavy and light load of the single-phase plant; but so soon as all the plant has been changed over to two-phase, both sides can be altered so that they measure and record the outputs of phases A and B at light and heavy loads respectively. To the left of the main boards there are two switchboards of 12 panels each for the single-phase distributing mains, supplying respectively Clerkenwell and St. Luke, and a six-panel board, now used for connecting up the single-phase motor generators to the circuits, but which later is intended for use in controlling the two-phase motor generators. On the right of the alternator switchboard, there are at present 12 panels for the two-phase mains, which supply current to the districts of Western Holborn and St. Giles. There is also room for two other sets of panels of 12 each, one for the mains for supplying the East End districts, and the other for extensions as may be required.




City Road Station: Diagrams showing Lamp Connection, and Units Sold per Quarter and per Year.
× Supply begun from City Road works, September, 1897.

Underneath each of the alternator switchboards are seen the handles regulating the resistance in series with the field windings of the main machines, with an ammeter in each circuit. The regulation of the general voltage of the station is effected by resistances placed on the regulating table, which control the governors of the exciter engines, and auxiliary regulation is provided by the switch pillars shown near the table, controlling the field magnets of the exciters. The two large switch pillars further from the table operate resistances by means of which the abrupt step of 2 volts, when using the exciting battery, is smoothed down. The whole of the switchboards, with the exception of those specifically mentioned, have been supplied by Messrs. S. Z. de Ferranti, Limited, who have devised a special double-expanding cone plug for linking up the two-phase bus bars.



City Road Station: Booster and Switchboards.

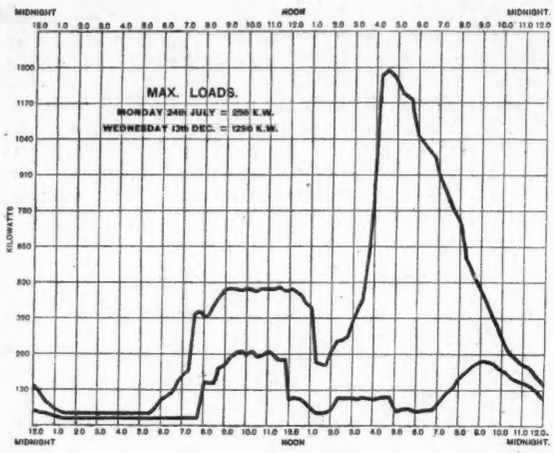
A very fine set of instruments for testing insulation, meters, &c., has been provided by Messrs. Elliott Bros., and is similar in all respects to the set at Wandsworth, which we illustrate below.

City Road Station: Workshop.

In the basement is a workshop, of which we give a view, provided with some of the most modern repairing tools, such as lathes, drills, shapers, &c., driven by an electric motor.

In order to obtain the consent of the Board of Trade to a change from the system originally inserted in the Clerkenwell order, viz., the continuous current system (the London Electric Company having an Order for the supply of alternating current in the district), the company had to agree to supply continuous current at 530 volts in both the Clerkenwell and St. Luke districts for motive power. Difficulties were also raised by the County Council as to the construction of transformer boxes under the streets, but the

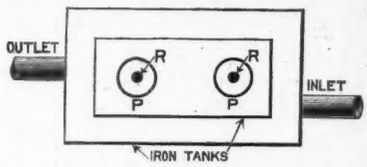
local authorities having consented to their use, a specially ventilated form of box was designed by the late chief engineer of the company, Mr. Lawson, and was approved by the Board of Trade.




City Road Station: Load Diagrams, Summer and Winter, 1899.

The draw-in system of mains was adopted by the company, and cast-iron pipes of 2 or 2½ inches diameter were laid throughout the whole district. A sufficient number of pipes was laid on all the routes to provide for duplicate high tension mains and for feeders from transformer boxes to various points along the routes of the low tension mains.

For alternating current high pressure supply the cables are paper insulated, lead covered, concentric two-conductor cables, of the British Insulated Wire Company's make, while for power supply, rubber insulated, two-conductor, concentric cables of the Silvertown Company's make have been used throughout. For the low-pressure distribution, which is at 100 volts, Callender jute and bitumen insulated two-conductor lead covered cables are used. On the latter cables, two-way house service boxes are provided at the rate of one to every four houses, the outer wire in each having a connecting link or fuse in the street service box, so that in case of need

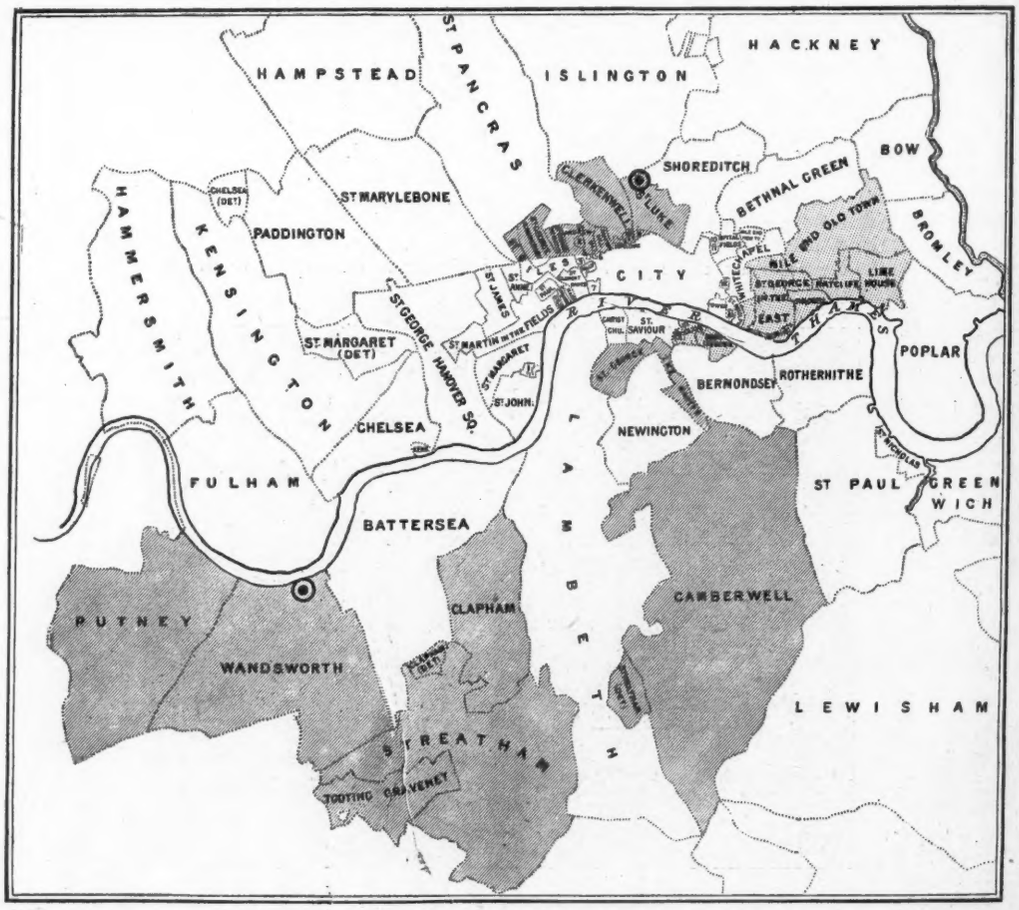



P P, Earthenware pipes; R R, Iron rods forming electrodes for alternating currents. (See page 404.)

Diagram showing Arrangement of Water Resistance.

any house may be disconnected from the supply mains without entering the premises. In the case of supply for motive power, the service cable is vulcanised on to the rubber insulated main, and is carried into a special service box within the consumer's premises, the joint invention of Mr. Lawson, Mr. Childs, and Mr. Dallas, which is covered by Letters Patent.

In the system of distribution from the transformer boxes, each of which is limited by Board of Trade rules for supply at low pressure to 75 KW. output, there is always a master box, to which the feeder from the station




Map showing the Areas of the Company's Operations.
Existing stations **O**. Districts in which mains are laid are shown thus //////.

A separate pipe of similar size was also provided for mains for public lighting, the lamps being fed in groups of 10 each from the continuous current mains.

is laid, and between this master box and some other, or between some of the other boxes on each circuit, an extra cable is laid, so that a complete ring system practically

prevails throughout the whole of the districts. For high and low pressure connections in these boxes, special switching gear designed by Mr. Lawson and Mr. C. E. Hodgkin, lately works manager of the Brush Company, has been provided. By the arrangement of these switches it is impossible to open the low pressure circuit without having first opened the high pressure one, also the inner on both circuits is opened before the outer, and in closing the circuits, the outer conductor of the low pressure circuit, and then the inner have first to be closed and then the outer and inner of the high pressure circuit. Subsequent improvements have been introduced by Mr. Lawson, Mr. Gosling, and Mr. Dalla.

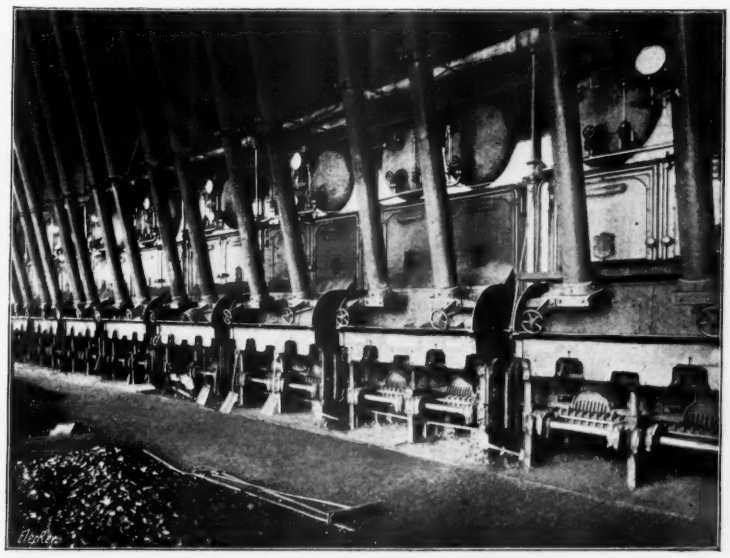
In Western Holborn and St. Giles, the whole of the mains have been laid for a two-phase alternating system of distribution, for both lighting and power, and to these mains current is supplied at a pressure on either phase of 100 volts; if one be fully loaded and the other unloaded, the difference is not more than 2½ per cent. When the whole change to 50-period two-phase supply is made, it is proposed to balance up the single-phase distribution mains on the switchboards at the station, so that the load may be as evenly divided as possible between the two phases, St. Luke being on one phase and Clerkenwell on the other, while the outlying districts shall be two-phase.

The length of trenching in the northern districts to date is about 35 miles, the length of pipes laid 100 miles, the high pressure and power mains about 33 miles, and the low pressure cables about 40 miles, whilst the number of transformer boxes is 50.

These districts, owing to their being chiefly of a business nature, have very much greater variation of load between summer and winter than the southern districts, which are chiefly residential; this is clearly shown in the load diagrams herewith.

The growth of the lamp connection and of the annual output is well seen in the curves which we reproduce; the shaded parts at the foot represent the power output, while the similar areas at the top of the last columns denote supply in bulk to other companies. It is interesting to note the extraordinary rate of increase of business; the output has been practically doubled each year, and the lamps connected (including a large allowance for motors) follow a similar law.

Wandsworth Station, showing Wharf and Coal Conveyer.



Battery of Eight Water-tube Boilers, with Mechanical Stokers.

### Wandsworth Station.

Owing to the peculiar configuration of the district of the Wandsworth District Board of Works, which extends from Richmond Park on the one side to the boundary of Camberwell at Streatham on the other, and which contains some densely populated parts, alternating with sparsely built areas, difficulties arose as to the selection of a site out of many offering. It was, however, deemed of the utmost importance to select one to which the fuel could be cheaply transported, and where a sufficiency of water for condensing purposes and boiler supply could be obtained; both these features were found at the mouth of the River Wandle, in which an almost constant level is maintained by means of the sluices and weirs, which have been made part of the general scheme of construction.

Both boiler room and engine room at this station are of oblong shape with square ends, thus avoiding any waste space as at the Northern station. The main buildings are built up of best stock bricks and cement, and the engine room and switch room are lined with glazed bricks, and floored with adamant tiles, as at St. Luke. At both stations, to prevent the hum of high periodicity alternating machinery being too easily conveyed outside, there are no windows in the side walls of the buildings, the engine rooms being lighted from the roofs. The chimney is 200 feet in height, of hexagonal shape and of an internal diameter of 12 feet at the top.

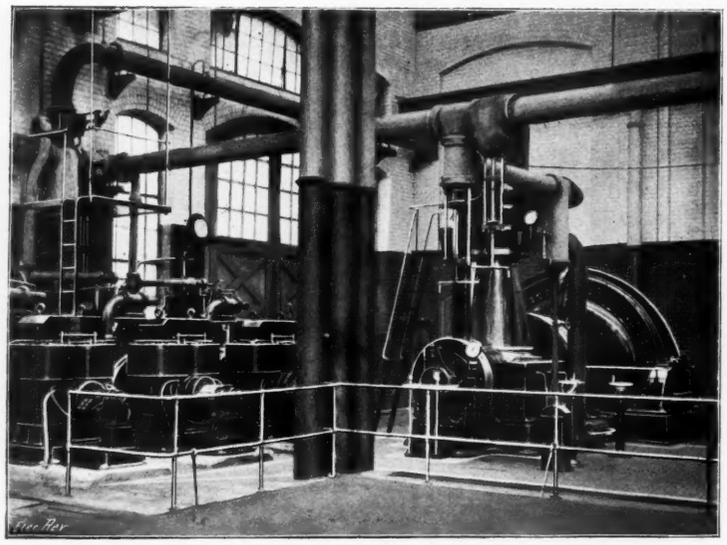
The accompanying view shows the buildings already erected, together with the coal wharf and the coal conveying gear.

The boiler room and engine room occupy half the available building space, and the foundations for the future extensions have been partly laid in, up to the ground level. The offices and switch room occupy two-thirds of the site available for such accommodation adjoining the main building, but the company is provided with ample space for additional offices or repair shops on the other side of the River Wandle.

G

The architect for these buildings was Mr. C. Stanley Peach, F.R.I.B.A., and the contractors, Messrs. Holliday & Greenwood.

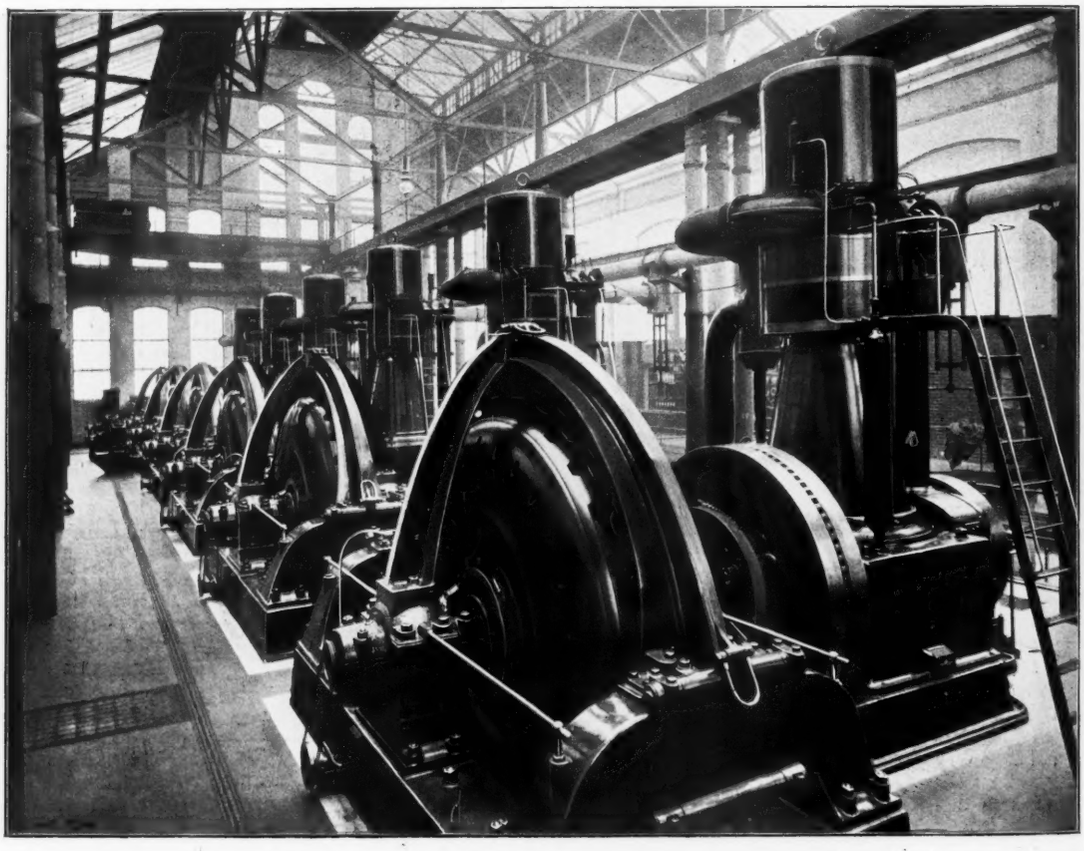
The boiler room is 68 feet in width by 110 feet in length. On each side of the room there is space for eight boilers with economisers and by-pass flues. One side is now fully occupied, and on the other side the foundations are already prepared for a similar equipment. Along the centre space, between the boilers and under the floor level, provision is made for ash conveying gear.



Exciter Sets and Steam Alternator.

The Babcock and Wilcox boilers are fitted with superheaters and Vicars automatic stokers, and the economisers are of Messrs. Green & Co.'s make. The economiser scrapers are driven by two small induction motors. The feed tank is of the same construction as at St. Luke's, and there are two Weir steam pumps of 4,000 gallons capacity per hour each, against a pressure of 150 lbs. per square inch, but injectors are provided as auxiliaries instead of motor-driven feed pumps.

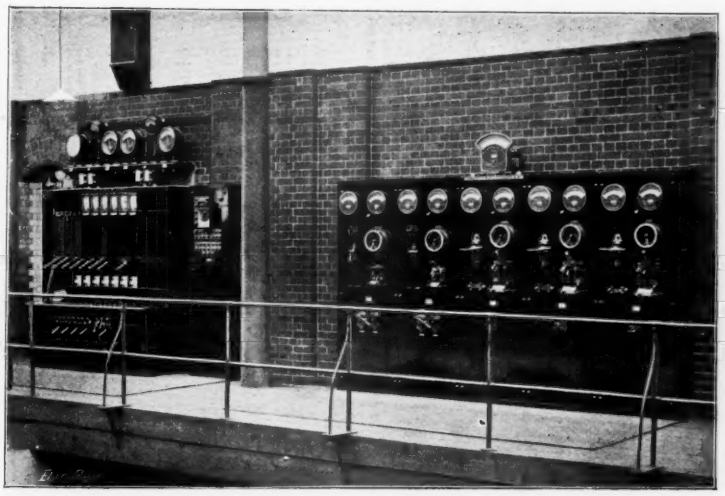
The coal store above is of exactly the same general construction as at the northern station, and has a storage capacity of about 1,000 tons. The system of coal conveyance from barges to the coal store differs considerably from that adopted at St. Luke's, the motive power throughout being electricity supplied through two-phase 50-period motors at 200 volts. The crane is fitted with a Hone grab; the weighing machine is of Messrs. Avery's self-recording make, and the conveyers themselves are of the push-plate type. The motors are of the Westinghouse Company's manufacture. The lifting crane, which, like the conveyers, is electrically operated, was made by Messrs. Jessop and Appleby, of Leicester and London. The contract for the whole of the work, including the constructional iron-work, was let to Messrs. Graham, Morton & Co., of Leeds, and the work was carried out by them to the designs and specifications of the company's late engineer. The apparatus is capable of dealing with 40 tons of coal per hour.



General View of Generating Sets.

Water storage is provided on the floor above the engine room, with similar arrangements for water filtering as at St. Luke's, to supply the make-up water, which is at present taken from the Southwark and Vauxhall Company's mains.

The engine room is 60 feet in width by 110 feet in length, and contains six Mordey single-phase alternating sets working at 100 periods per second, 2,000—2,200 volts and of 180 KW. capacity, each driven by a Raworth Universal engine; these are installed on the side of the engine room next to the boiler room. On the other side provision has been made for five 400-KW. two-phase 50-period 2,000 to 2,200-volt alternators, now on order, to be driven by improved Universal engines, one on each side of a Mordey inductor alternator.

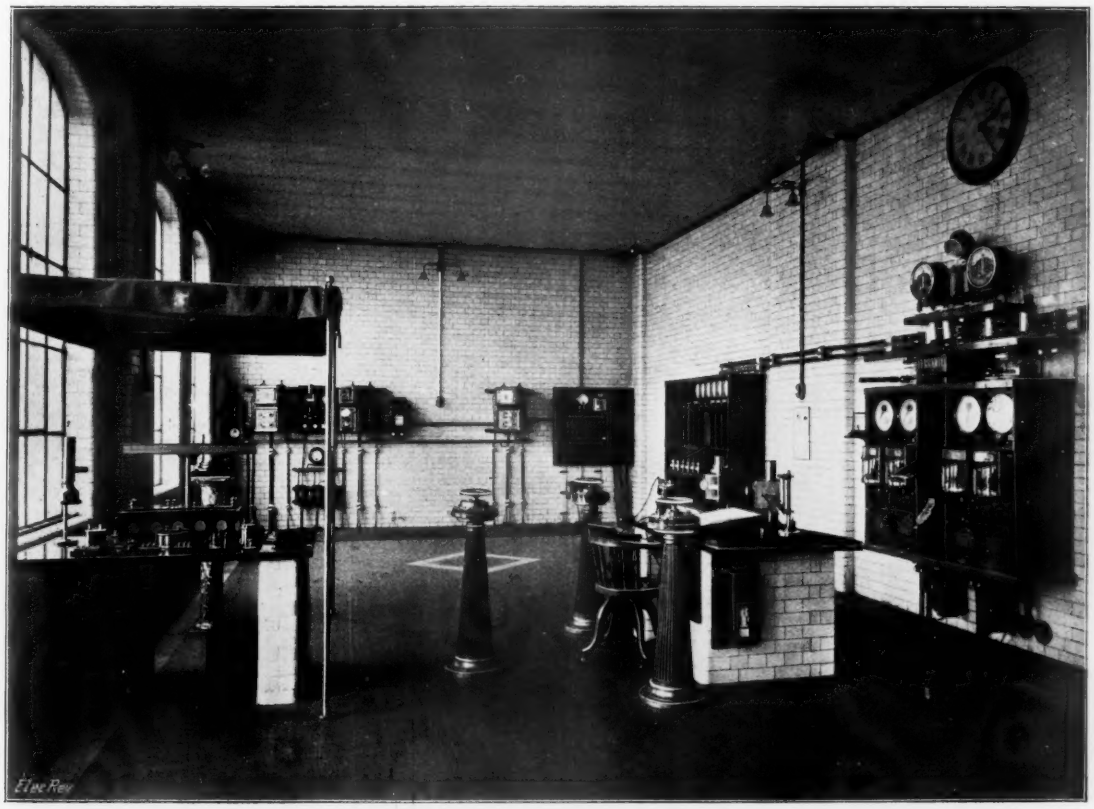


Generator and Exciter Switchboards.

To provide for the practical parallel working of these machines of different periodicities and for economical working at times of light load by the use of one engine and alternator only, a G.E.C. motor generator, as at St. Luke's, has been provided for.

The exciting current is provided by three Brush continuous current compound wound dynamos, driven by Brush marine type cross compound engines fitted with electrically-controlled governors. The steam piping is similar to that at St. Luke's, save that there is no cross-feeding between the ends of the building. The overhead cranes are of 20 tons capacity each and were supplied by Messrs. Vaughan & Son. Circulating water from the Wandle comes into two separate tanks beyond the foundations for future extensions, and is circulated through the condensers, which are placed in this case under the floor level, by means of steam-driven centrifugal pumps, one of which is spare. The air pumps are also under the floor level and are driven by a disc crank off each engine shaft. The condensed water is led off from these pumps by gravity to a tank connected with a Weir feed pump, with an automatic valve admitting or shutting off steam according to the quantity of water in the tank, which lifts the water to a feed-water tank.

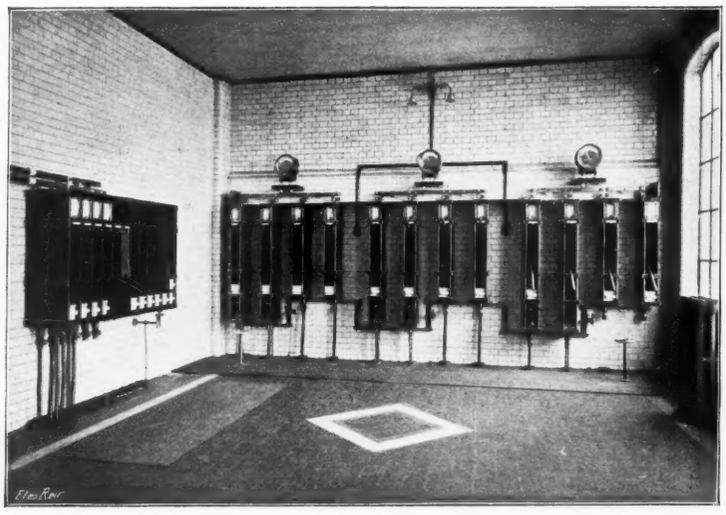
The main switches for alternators, exciting circuit switches and rheostats are within the dynamo room, the current being carried by bus bars through the wall into a dividing board in the switch room. To the left of this main measuring board are the circuit panels for the mains for Putney Wandsworth, Wandsworth Common, &c., while to the right there are 12 panels for transformer switches, controlling extra high-tension transformers placed in the basement of the switch room. These transformers raise the voltage from 2,000—2,200 to 6,000—6,600 volts, the E.H.T. side being connected with the panels shown at the southern end of the switch room, whence the extra-high-tension mains lead to the main dis-



View of Switch Room, showing Regulating and Testing Tables, Measuring Board, and Feeder Switchboards.

tributing transformer stations at Clapham, Streatham, and Camberwell. Here the extra-high-tension is transformed down to 2,000—2,200 volts and delivered to transformer sub-stations similar to those at St. Luke's.

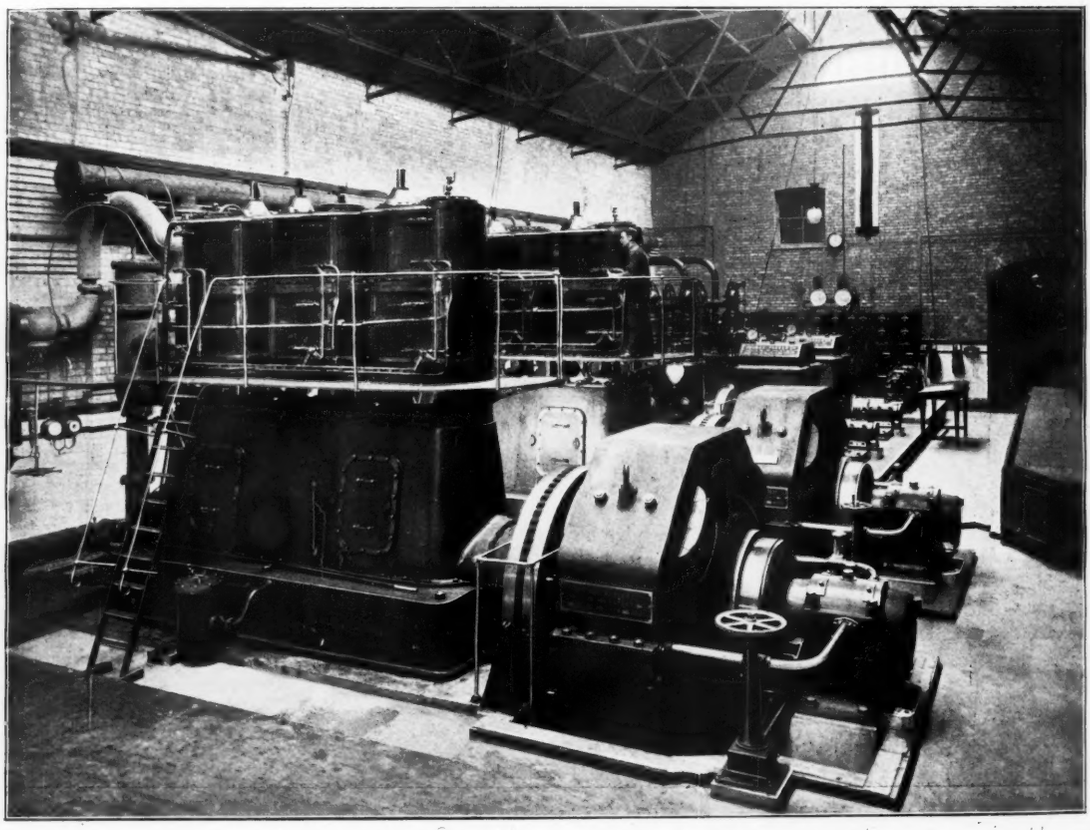
As showing the extent of the area supplied from this station, it may be mentioned that while Roehampton by Richmond Park Gates on one side is distant along the route of mains from the Wandsworth station $3\frac{3}{8}$ miles, the farthest point in Streatham, still within the district of the Wandsworth Board of Works, is $5\frac{1}{4}$ miles, and Clapham, by way of Battersea, is distant from the station $5\frac{5}{8}$ miles. Camberwell parish, however, which extends $5\frac{1}{4}$ miles from north to south, and $2\frac{1}{4}$ miles from east to west, has its extra-high-tension distributing station at a distance of no less than $10\frac{1}{4}$ miles from the Wandsworth station, while the extreme point in St. Olave's parish is $13\frac{1}{2}$ miles away, and is within the comparatively short distance of $2\frac{1}{4}$ miles of the City Road



Step-up Transformer Switchboard, and Extra-High-Pressure (6,600 volts) Switchboard.

the E.H.T. and H.T. mains consist of rubber insulated two-conductor cables lightly sheathed with steel and taped over, all made and supplied by the India-Rubber and Gutta-Percha Company, Silvertown, while the low tension cables are Callender's jute and bitumen insulated, lead-covered two-conductor concentric cables. For St. George-the-Martyr the high tension cables are of Messrs. W. T. Glover and Co.'s make with paper and diatrine insulation and lead sheath, and are likewise of the concentric two-conductor type.

The low tension current throughout the whole of these districts is supplied at 200 volts, and the change from 100 ~ to 50 ~ is already commenced. It was decided to distribute current as single-phase in the Wandsworth district, where hardly any demand for power is likely to arise, balancing the lighting load as evenly as possible between the two-phase primary conductors, while in Northern Camberwell, St. George-the-Martyr and St. Olave, Southwark, where



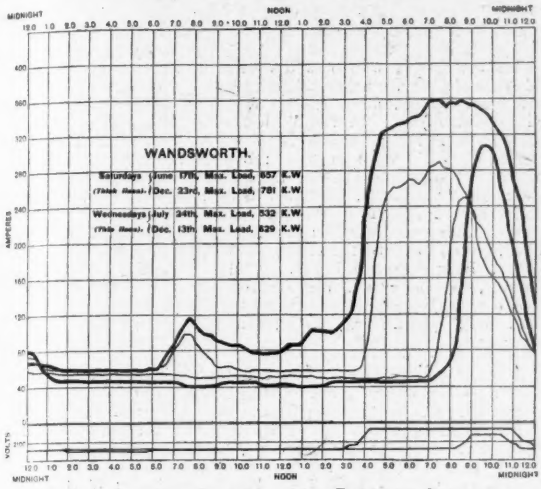
Enclosed High Speed Engines and High Pressure Dynamos for Electric Traction at Hull. (See page 449.)

station, from which, however, several geographical and special local conditions at present prevent its obtaining a supply.

The mains throughout the whole of the Wandsworth and Camberwell Districts are drawn into cast-iron pipes; considerable power may be required, the mains have been laid for a two-phase supply for both lighting and power.

In the Wandsworth, Camberwell, and Southwark districts, the length of trenching and reinstatement to date amount to

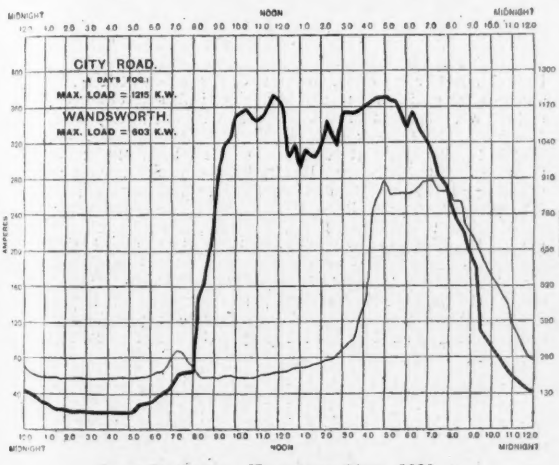
about 75 miles, the length of pipes laid in to over 150 miles, high and extra-high-tension cable to nearly 50 miles, and the low-tension cable to over 52 miles. With the higher voltage




Wandsworth Station: Load and Pressure Diagrams, Summer and Winter, 1899.

on secondary mains, the number of transformer boxes for the much larger area is about the same as served from the City Road station, namely, 50, with three extra-high-tension converting and distributing stations above ground.

In these southern districts the Saturday night loads are generally the highest of the week, and as many private




Load Diagrams, November 30th, 1899.
City Road output in kilowatts; Wandsworth output in amperes (at 2,100 volts).

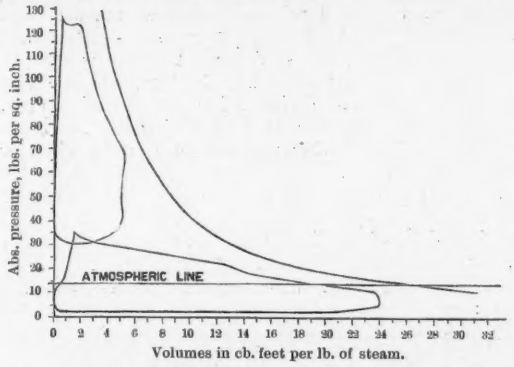
residences are connected to the mains, a fairly large load is obtainable on Sundays, thus strangely contrasting with the St. Luke's station, where the Saturday and Sunday loads are very small.

Representative load diagrams for two days each in mid-summer and mid-winter are given above for Wandsworth, as well as a diagram showing City Road revelling in dense fog, while at Wandsworth the load is almost normal.

## NEW STEAM DYNAMOS FOR ELECTRIC TRACTION AT HULL.

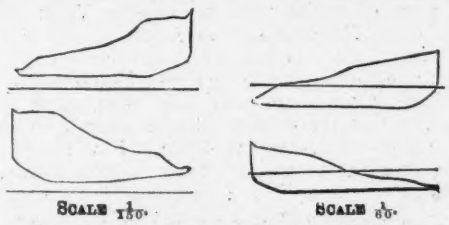
On the opposite page we give a view of two generating sets recently installed in the Hull Corporation Tramway power station.

The engines, which were built by Messrs. W. H. Allen, Son and Co., are of the enclosed high-speed tandem compound type, having three cranks at 120° actuated by three pairs of tandem cylinders, the high pressure cylinders being placed on the top of the low pressure. The engines are capable of developing 750 I.H.P. each, and run at a speed of 270 revolutions per minute, with a boiler pressure of 140 lbs. Each engine is fitted with one of Ledward's ejector condensers. The three high pressure cylinders are each 12 inches in diameter and the low pressure cylinders 26 inches diameter, with a stroke of 12 inches; the three sets of cylinders and their working parts are exactly similar to one another, thus ensuring an even turning moment at all loads. The cylinders are cast separately, and each pair is fitted with one piston valve arranged to distribute the steam to both high and low pressure cylinders, the valve chest being constructed so that each set of valves can be withdrawn and examined by removing the high pressure valve chest cover only. Each set of high and low pressure cylinders, together with their valve liners, is bored out after they are faced and bolted together, so as to ensure their being true and accurately in line. The high pressure cylinders are fitted with steam jackets supplied with boiler steam. The valves are of the piston type having solid rings, and all the ports are made straight so as to be as short as possible, and self-draining.




Combined Indicator Diagrams.

The cylinders are mounted on a cast-iron trunk with intermediate distance pieces, having a special arrangement of bush in the bottom of the distance piece, by which the water is prevented from finding its way into the trunk, and the oil is prevented from working up into the cylinders. The trunk is fitted with three hinged doors at the front fitted with two handles each, and two bolted doors at the back, so that the working parts of the engine are very accessible. The trunk is carefully stiffened in order to allow the door at the front to be made as above described without causing any undue weakness; this point is one of some importance, as a not unusual complaint against engines




High and Low Pressure Indicator Diagrams.

having enclosed working parts is that on account of the trouble of opening the bolted doors the moving parts are not easily accessible.

The whole of the working parts are made of mild Siemens-Martin steel, and the pins for the crossheads of a specially hard and tough steel.

The eccentric sheaves are forged solid with the shaft, and have straps of cast steel. All the bearing surfaces are unusually large in order to ensure that the engine will run steadily and without giving trouble at all speeds and loads. The crankshaft is made 7 inches diameter at the end farthest from the dynamo and 8 inches at the dynamo end, where the maximum turning moment has to be transmitted. An additional large bearing is provided at this end of the shaft to carry the weight of the armature without any appreciable amount of wear, so that the armature can be kept truly central with regard to its field.

The main bearings and big ends are all lined with white

metal, the shells of the bottom half of the main bearings being made of cast-iron and the caps of steel.

The engine is fitted with a system of forced lubrication, the oil being forced to all the working parts by means of a special valveless oil pump worked from one of the eccentrics under an average pressure of about 25 lbs. per square inch. The result is that the mechanical efficiency of the engine is very high, being about 92 per cent.

The governor is of the crankshaft type, and works on a throttle valve, the maximum variation of speed being not more than about 2 per cent. The governor is capable of being regulated by hand when running, so as to give a variation of 5 per cent. in speed above or below the normal.

The dynamo, of Messrs. Thos. Parker's make, is designed for an output of 460 KW. at 270 r.p.m., the pressure being 2,250 volts. The machine is of the four-pole type, and the armature is series-wound, so that only two sets of brushes are required; these are placed on the underside of the commutator, and are adjusted by means of a hand-wheel and rod, which passes through one of the pillars supporting the guard-rail. The armature is wound with Eickemeyer coils, the patent for which in the United Kingdom is owned by Messrs. Thos. Parker, Limited. The field magnets and outside bearing are fixed in massive sole-plates built into the foundations; the field magnet frame is cast in two pieces divided in the horizontal plane, and the end bearing, which has been designed in a very liberal manner, is made to swivel so as to ensure good alignment, and can be removed without lifting the armature out of place or unsetting the pedestal. The armature shaft is provided with a solid forged coupling for connection to the engine shaft.

The first of these machines was started up on September 15th, 1899, and was thrown on to the mains the next day.

The following are the results of the official trial of one of the sets :—

Average indicated horse-power, 706.
Average electrical horse-power, 623·7.
Total overall efficiency of engine and dynamo, 88·4 per cent.
Total lbs. of water per hour, 11,870.
Steam per I.H.P. per hour, 16·8.
Steam through cylinders, 16·57 lbs. per I.H.P. per hour.
Steam through jackets, 234 lb. per I.H.P. per hour.
Steam per B.H.P. per hour, 19 lbs.
Average vacuum, 26·9 lbs.
Average pressure of steam, 140 lbs.
Average revolutions per minute, 262.
Average pressure, 2,254 volts.
Average current, 206·4 amperes.

It will be noticed that the average efficiency of the combined set is very high, although it was not quite fully loaded at the time of this trial.

The combined indicator diagram shown has been worked out on the principle enunciated by Prof. Osborne Reynolds in his paper on engine trials, published in Vol. 99 of the minutes of the *Proceedings of the Institution of Civil Engineers*. In this diagram, each of the indicator diagrams is set back into the clearance space through a distance equal to the volume of the steam shut in at compression at each pressure, so that the expansion line is strictly comparable with the saturated steam curve shown. It will be seen that there is a considerable amount of steam missing at admission to the high pressure cylinder; this is probably due to the steam supplied being wet, on account of the fact that the steam pipes were not properly lagged at the time when the trial was made.

The effect of the high pressure jacket in re-evaporating the water is very marked; this diagram would indicate that if the engine was supplied with perfectly dry steam, considerable increase in economy might reasonably be expected.

---

**XXX Rays?**—It was stated in a seaside Town Council last week that the arc lamps on the sea front were perfectly blue! The author of this remark admitted that he observed the remarkable effect late at night, but declared that a dozen of his friends saw it at the same time, and they could not all be wrong! Another critic agreed, but said he generally saw them purple, and thought it might depend on the time of night. Whether the lamps were of the double or single type was not stated.

## NEW COMPANIES REGISTERED.

**Ingram & Kemp, Limited** (65,249.)—This company was registered on March 5th, with a capital of £30,000 in £1 shares, to acquire the business carried on at Newtown Row and Mosson Street, Birmingham, and elsewhere, under the style of "Ingram and Kemp," to adopt an agreement with Clifford W. Kemp, and to carry on the business of workers and dealers in iron, brass, copper, and other metals, tube, pipe, chandelier, bracket, and gas, water, electric, and other fittings, manufacturers, &c. The first subscribers (each with one share) are:—Clifford W. Kemp, 232, Bristol Road, Birmingham, manufacturer; Thomas R. Townson, Wool End Road, Erdington, Warwick, works manager; Bernard B. Blackburn, 21, Westminster Road, Handsworth, Staffs, assistant works manager; Harcourt Ashford, 39, Waterloo Street, Birmingham, chartered accountant; Henry F. Farrow, Beaufort Road, Gravelly Hill, Birmingham, incorporated accountant; Harold G. Vernon, 113, Leonard Road, Handsworth, Staffs., clerk; and William Johnson, 36, Waterloo Street, Birmingham, solicitor. Clifford W. Kemp is the sole director, and may retain office for life. After his death or resignation, the number of directors is not to be less than three nor more than five; qualification, £500; remuneration as fixed by the company.

**Adams Electrical Generator Company, Limited** (65,266).—This company was registered on March 6th, with a capital of £5,000 in £1 shares, to acquire the invention of G. E. Adams for an improved apparatus for generating electrical pressure, and to carry on the business of electricians, electrical engineers, &c. The first subscribers (each with one share) are:—G. L. Adams, Bush Lane House, Cannon Street, E.C., electrical engineer; W. S. Jerome, 14, Osborne Road, Stroud Green, N., clerk; P. B. Pearce, 9, Herbrand Street, W.C., licensed victualler; J. B. Reiner, Cholmondeley Cottage, Richmond, Surrey, gentleman; H. Vroom, jun., 97, Gower Street, W.C., civil and mining engineer; R. Pastorelli, 4, Grosvenor Villas, Gunnersbury, gentleman; and H. Howard, Lansdowne, St. Helen's Road, Hastings, gentleman. The number of directors is not to be less than three nor more than seven. The first are G. L. Adams, W. S. Jerome, H. H. Howard, R. Pastorelli, and P. B. Pearce; qualification, £10; remuneration £10 each per annum.

**Hands, Limited** (65,285).—This company was registered on March 8th, with a capital of £50,000 in £1 shares (10,000 preference), to acquire the business carried on at Garlick Hill, Hatchet Court and Snow Hill, London, as "Albert Hands," the business carried on at Hatton Garden, London, as "W. T. Burbey and Co," and the business carried on at Birmingham as "Harold Davis," and to carry on the business of art metal workers, electrical and general engineers, machinists, electrical and other apparatus makers, &c. The first subscribers (each with one share) are:—B. H. Jenkinson, 21, Garlick Hill, E.C., electrical engineer; William J. Wallis, 13, Placquett Road, East Dulwich, S.E., clerk; Ernest F. Goodrich, 116, Ladywell Road, Ladywell, S.E., clerk; Henry Challoner, 4, Croydon Road, Penge, S.E., warehouseman; Henry C. Channing, 64, Princess Road, Kilburn, N.W., warehouseman; Alfred E. Higgins, 9, Belmont Road, Clapham, S.W., book-keeper; and George Hands, St. Colomb, Mansfield Road, South Croydon, traveller. The number of directors is not to be less than three nor more than six. The first are Albert C. Hands, William T. Burbey, Harold Davis, George Hands, Ben. H. Jenkinson, and one other to be appointed by the Law Guarantee and Trust Society, Limited; qualification, £500; remuneration as fixed by the company. Registered office, 21, Garlick Hill, E.C.

---

## CITY NOTES.

### The South London Electric Supply Corporation, Limited.

THE directors' report for the year ending December 31st, 1899, presented at the meeting of shareholders held yesterday, reads as follows:—

"In making their annual report the directors have to state that the extensive works at Bengeworth Road, Loughborough Junction, are, with the exception of one large steam alternator and certain thermal storage arrangements, now complete, and that the various contracts are practically concluded. Mains have been laid in all the compulsory streets as also in a number of other streets throughout the area of supply where a demand for current was likely to arise. The remaining large steam alternator has now been delivered and is in course of erection. The thermal storage plant has been somewhat delayed in order to benefit by the experience derived from the use of similar arrangements elsewhere and to take advantage of improvements in design. The directors are glad to record that the work at the station has been well carried out, and that, with some minor exceptions, the machinery is proving satisfactory. When the works were approaching completion in the early autumn of 1899, the directors were able to commence taking over the electrical load, and on November 28th, 1899, to terminate the contract under which energy was being obtained from a neighbouring company. The corporation has, therefore, been relying on its own resources for three months, and the commencement of this year may be regarded as the date from which the real

business of the corporation begins. At the present time, electricity is being supplied to the equivalent of 26,688 lamps of 8 C.P., and applications have been signed for 3,185 more. In addition to this, current is being supplied temporarily to a supply company in an adjoining district. The board have applied to Parliament for powers to supply electricity in that portion of Lambeth north of and including the Westminster Bridge Road, that part of the parish in fact which was not included in the Lambeth Lighting Order of 1892. A petition for admission into that district of this corporation's system has been signed by many of its residents, and the decision of the Board of Trade is shortly expected. This area, comprising, amongst others, Westminster Bridge Road, Waterloo Road, Belvedere Road, York Road and Commercial Road (Lambeth), can readily be supplied from the existing station, and if powers are obtained, the new area should prove a valuable additional source of revenue. There appears to be a growing demand for current to be used for motive power. At present there are a number of motors on circuit and applications are to hand for more ranging from ¼ to 16 H.P. The dust destructor has been at work some 10 weeks, but the full quantity of ash-bin refuse which it is capable of consuming has yet to be supplied under the Lambeth Vestry's contract, which comes into operation at the end of this month. No difficulty has been experienced in destroying all the refuse obtainable. A reference to the accounts will show that they have been drawn up in the form prescribed by the Board of Trade, the net revenue account exhibiting a profit of £295 0s. 6d., which has been carried into the general balance-sheet. In accordance with the articles of association, two of the directors, Bennett Fitch, Esq., and Captain E. Ironside Bax, retire, but, being eligible, offer themselves for re-election. The auditors, Messrs. Price, Waterhouse & Co., also retire, and being eligible, offer themselves for re-election."

## The Bournemouth and Poole Electricity Supply Company, Limited.

THE report to be presented to the meeting at Winchester House, E.C., on Monday, March 19th, at 2 o'clock, reads as follows:—"The directors beg to submit their report and statement of accounts for the year ended December 31st, 1899. The whole of the undertaking of the Bournemouth and District Electric Supply Company, Limited (in course of voluntary liquidation), has now been vested in the company. Expenditure has been incurred during the year on capital account in respect of the Bournemouth Provisional Order, 1890, particulars of which are given in capital account No. 4. The agreement, dated November 6th, 1899—duly confirmed and adopted by the shareholders—for the purchase of the interests of the County of London and Brush Provincial Electric Lighting Company, Limited, in the Richmond (Surrey) Electric Light and Power Company, Limited, has been carried out. The balance of the authorised share capital of the company was issued to the shareholders in December last, and the premiums received therefrom, after deducting the expenses of issue, have been carried to reserve. The balance from revenue account, together with the balances brought forward from last year, amount to £8,993 8s. 7d., from which must be deducted interest charges, depreciation, &c., leaving the sum of £6,799 13s. 5d. to the credit of the net revenue account. Out of this sum the full year's dividend on the preference shares (first issue) has been paid, and the directors now recommend the payment of a dividend on the ordinary shares of the company (first issue) at the rate of 5 per cent., less income-tax, for the year ending December 31st, 1899. These payments absorb £5,510, leaving a balance of £1,289 13s. 5d. to be carried forward. The equivalent of 44,096 8-C.P. lamps were connected to the company's mains in Bournemouth at December 31st last, showing an increase of 10,364 8 C.P. lamps for the year, and applications representing a further 681 8 C.P. lamps were then awaiting connection. Terms have been arranged for the supply of power for a period of years to the Poole and District Electric Traction Company, Limited, for the purpose of working the tramways between Bournemouth and Poole. A provisional order for the Borough of Christchurch, and the districts of the Urban District Council of Winton and the Rural District Council of Christchurch, was granted to the company by the Board of Trade, and confirmed in the last Session of Parliament. The Richmond (Surrey) Electric Light and Power Company, Limited, has declared a dividend upon its ordinary shares at the rate of 4 per cent. per annum, in respect of the year ended December 31st last. Of the revenue received from the Richmond undertaking, the sum of £2,400 has been applied to reduction of the cost of purchase in respect of interest and dividends accrued at the date of purchase. The retiring directors are Mr. F. E. Savory and Mr. R. Percy Sellon, both of whom, being eligible, offer themselves for re-election. The auditor, Mr. R. H. Marsh, also retires, and offers himself for re-election."

## Alliance Electrical Company.

THE annual general meeting of the shareholders of the above company was held on Thursday last week at Winchester House, Mr. George Verity presiding. In moving the adoption of the report, he congratulated the shareholders upon the successful result of the year's trading, and upon the satisfactory condition in which the company and its affairs now stood. Since the report had been published the attention of the directors had been called to the possibility of legal difficulties arising if the whole profits of the business from February 1st, 1899, to February 1st last were treated as profits available for dividend. In the purchase agreement it was stipulated by Veritys, Limited, the vendors, that the sale should take effect as a going concern, and consequently that all profits from February 1st, 1899, should be available for dividend on shares in this company, and the accounts had been made up on that basis. There was, however, some doubt if that could be done, and while the doubt existed the directors felt that the company ought not to take any course which would expose them to legal objections later on. The result would be therefore that the ordinary shareholders instead of getting a dividend at the rate of 10 per cent. from February 1st, 1899, could only get a dividend at that rate from the end of July, while for the other period they would have to be content with interest upon the purchase money at the rate of 5 per cent. The directors proposed to apply the amount not divisible, viz., £2,059, in entirely writing off the preliminary expenses of the company—£2,017—and the balance of £41 for the patterns account. With regard to the £10,300 cash at bankers and in hand, and with partly represented capital unemployed, he would call their attention to the fact that in the prospectus it was proposed to open up another branch in Edinburgh to cope with the electric lighting business there and in the North, for which additional capital would be necessary; while it was anticipated that further capital would be required for the extension of the business in connection with motive power. The latter, which comprised such a widely diversified field, the company intended to pay the utmost attention to—electric motors, and the uses to which they could be put, not only for the more important services of power distribution, but also for the many minor applications where they could be profitably employed in town or country houses. They anticipated that as the advantages of electric motive power became better known the company would erect few important installations in London, and certainly hardly any in the country without the use of one or more motors for some purpose or other. They had in their showrooms at Regent Street several motors at work operating different useful apparatus. They thought that in the future their surplus capital could be profitably utilised in the direction of increased business in connection with motive power, and as the present seemed an unfavourable opportunity for opening a new branch in the North of England, the directors had decided to sit tight on the company's money bags. The possession of the capital would give them greater strength all round and enable them to avail themselves of many advantageous opportunities of adding to their profits which otherwise they might have to pass by. In connection with the Exhibition now being organised in Regent Street, where wireless telegraphy, Röntgen rays, and the latest developments in telephones and electric power would be shown in operation, they also hoped to introduce to the public some new developments in connection with the use of the electric current, which should produce further profitable work for the company to undertake.

Mr. J. ELWIN COLES seconded the motion, which was agreed to.

Subsequently a resolution was passed to split up the £10 ordinary shares into £1 shares.

## Metropolitan Electric Supply Company, Limited.

ON Tuesday last the annual meeting of this company was held at Winchester House, E.C., Mr. W. H. Cripps presiding.

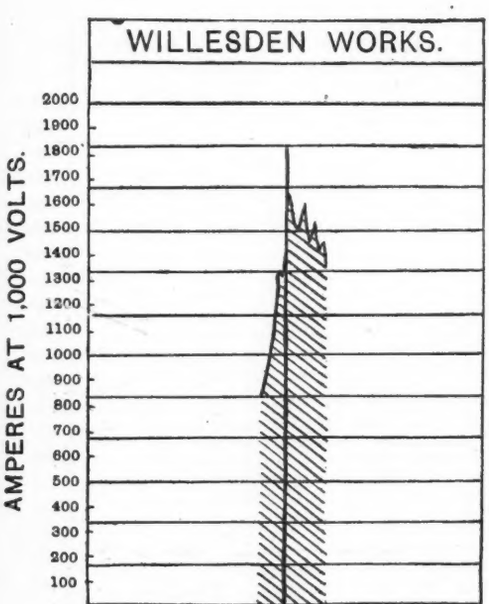
In moving the adoption of the report and accounts, which appeared in the ELECTRICAL REVIEW last week, the CHAIRMAN said that the capital expended by the company at the end of 1898 was £993,000, and at the end of 1899 £1,244,000—increase over £250,000. This had been expended chiefly on the new station at Willesden (£141,000) and upon the laying of new low pressure mains (about £110,000.) The expenditure was expected to lead to very considerable economy. As to the economy of the Willesden station there was no doubt, and the economy of the low pressure mains would result in their being able to remove the house transformers after a while, so as to get rid of what had been a source of great waste—nearly 50 per cent.—of the electricity produced. It was their intention to make this change throughout. The total received on the credit side during the year was £231,000, of which £106,000 represents the balance of the shares issued to the founders in exchange for theirs. The remaining £125,000 was the issue of half of the new debentures. The old debentures were issued at 4½ per cent. and the new at 3½, and the price obtained in the market was 97, which spoke well for the financial condition of the company. It would be necessary almost immediately to issue the remaining £125,000 debentures to meet immediate wants, though they might not get so good a price as last summer, because of the unfavourable time of issuing. In regard to the revenue, the units sold in 1898 were 6,800,000 and in 1899 8,300,000, and increase of 1½ millions. The revenue in 1898 was £146,000 and in 1899 £173,000—increase for the year £27,000. The increase in the units sold and revenue were both relatively higher than in any year of the company's existence. The units sold would represent double the amount in three years. They sold last year double the amount of three years ago and the revenue was double what it was 4½ years ago, a most satisfactory increase. As regards expenses, in 1898 they spent £111,000, and in 1899 £125,000—an increase of £14,000. To a certain extent he could not help regretting that the increase was so large, but the reason admitted of easy explanation. It included no less than £10,000 increase in cost of coal. First they had to use a larger quantity than in 1898 owing to the increased supply; secondly, the price of coal was higher, although they had made contracts for the supply of coal before the price rose to its present figure. But the chief reason of the increase was the difficulties under which they were working during the year. They had the greatest trouble to keep up the supply, and rather than that the supply should fail totally they did all they could to use forced draught to keep the engines properly supplied. That meant a large consumption of coal. Now they were in comparatively easy water, and hoped for a great

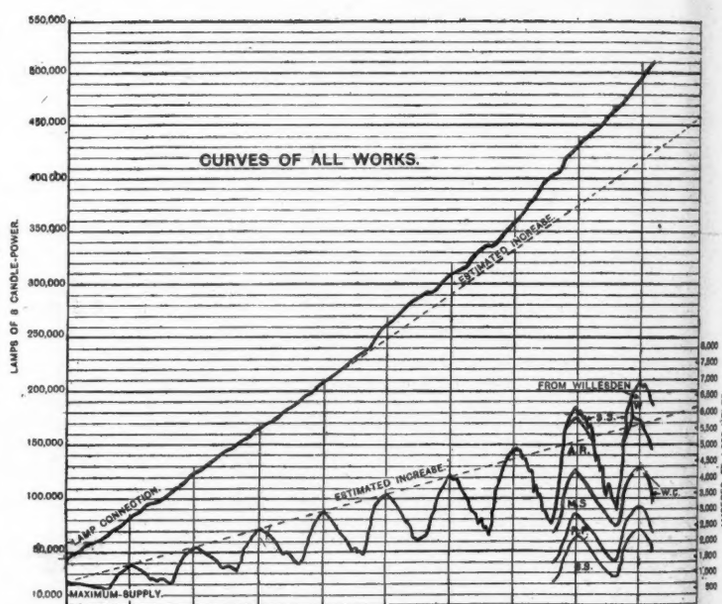
economy in coal consumption in consequence. Repairs had been somewhat heavy, but this arose from the same cause, namely, they had to work at high pressure all the way through, and had no time for keeping the boilers clean, and so on. Parliamentary charges were high for 1899, but for 1900 they would be considerably less. Nearly every year the company had had to fight for its existence. Depreciation was added to by £13,000, this being considered the right sum to put by under the circumstances. Deducting the working expenses and the depreciation sum, there remained £53,000 which was £12,000 in excess of 1898. £25,000 had been paid in interim dividend and other expenses, and there remained for division £25,666. They proposed declaring 5 per cent. on the ordinary shares, and carrying over £4,400, which was £3,000 more than last year. Considering the difficulties under which they had worked, and considering that they had over £200,000 spent at Willesden, which had not begun to earn a penny until December 15th, it was not unsatisfactory that they had been able to maintain the dividend. As stated in the report, Sardinia Street station was required by the L.C.C. because it was in the middle of the proposed new street. The company looked upon it as an extremely serious matter to have to part with a station in the very centre in London, but they had the most adequate protection in every way. The L.C.C. were going to give them land equivalent to that of the old station, and they would put up a new station, with completely new machinery, not only sufficient for present wants but the requirements of two or three years' time when the station was ready. They had given the company an option, which they did not know whether they would use, so that they might have the money instead of putting up the station at all, and work from Willesden. Last year the Central Electric Supply Company applied for powers to erect a station in Marylebone district on the Regent's Canal. That company was a wolf in sheep's clothing, and he was pleased to say that the hands of the new company had been so tied that they would not be able to supply within the Metropolitan Company's area. After referring to the strengthening of the board by the addition of new directors, the chairman made some comments regarding the Willesden works. As the works only started to supply on December 15th, they only had a fortnight's run last year. From that time up to the present they had had no electrical hitch of any kind in the works. Considering that they were working upon practically a new system—they had to bring their cables 6 or 7 miles into London, with an innumerable number of joints—this did great credit to their engineers. They had had some slight minor troubles, such as hot bearings and things of that kind, but these had all been got over, and at the present time the engines are working satisfactorily. They had there at present three 1,500 KW. sets, which gave them 7,500 H.P. available and working. For next winter they would have an additional 2,500-H.P. set, making 10,000-H.P., but this was only a small part of the capacity of the Willesden station. As the business expanded they had any amount of room, the works being designed for five other sections of the same size as the present one. In regard to the difficulties of supply, these all arose from the same cause; they made every effort to get Willesden ready in time, and thought they had a margin of nearly nine months, but owing to the failure of some contractors to deliver work at the right moment they found themselves in the middle of October short of current, but only to a very small amount. Only one-tenth of their customers were affected, and most of them only for a very short period. Most of their customers did what they could to help the company by burning as little as possible, but a few applied to the magistrate for the enforcement of various penalties. The magistrate's judgment, which the chairman read to the meeting, showed that the board and officials had done their best to get everything ready in time, and he only imposed a fine of 2s. 6d. instead of £5 a day. The board thought it right, however, that those who had suffered and been put to expense should receive some proper compensation, and they allotted a certain sum of money which was divided proportionately to meet them in a reasonable and fair manner. Some of their men had been called out as reservists, and they were doing their duty by them and their families.

Sir James Pender seconded the adoption of the report.

Messrs. Conway Bishop and Young asked various questions, and in reply,

The Chairman said that the Westminster Company had an entirely different method of supply, viz., continuous. The Metropolitan supplied alternating, and he only wished they had been able to start with continuous current 15 years ago. They would have been able to dispense with the great waste in house transformers in their district, and would have had reduced coal cost. They were now laying down the necessary mains for supplying the continuous current in most of their districts, and that would lead to saving. It would have been quite impossible or ruinous when they started; the other companies, with their district all around them, could do so with perfect ease. The supply of the City of Liverpool was not to be compared with the Metropolitan with its half a million lights and its many different stations. They could not expect that at the present stage of electric lighting never to have an accident. With the exception of Marylebone, the supply had been practically uninterrupted. There had been no complaints from any other district. In regard to the Board of Trade deputation, there was a very strong element on the Vestry to get the electric lighting plant into their own hands, and whenever an opportunity occurred they went to the board, and said how excellent would be a supply conducted by themselves. The Metropolitan were very active competitors with the Charing Cross Company, and that was why they tried to get the powers for lighting the City.




S.S. = Sardinia Street station; A.R. = Amberley Road station; M.S. = Manchester Square station; R.P. = Rathbone Place station W.C. = Whitehall Court; W. = Willesden.

The report was unanimously adopted, the retiring directors and auditors re-elected, and a hearty vote of thanks given to the board and staff.

---

The great interest which has been directed towards this company impels us to reproduce the above curves, which were exhibited at the annual meeting on Tuesday last. We are enabled to do this by the courtesy of Mr. Reginald R. Todd, the engineer-in-chief. The curves show the increase in lamps connected and the output from all the stations since the company started working. The marked upward tendency of the curves, showing an *increasing* rate of increase, is highly gratifying to those who wish well to the company.

---

## The Richmond (Surrey) Electric Light and Power Company, Limited.

The report to be presented to the shareholders at the general meeting at the offices, Moorgate Court, Moorgate Place, E.C., on Monday, March 19th, at 12 o'clock, reads:—"The directors beg to submit their report and statement of accounts for the year ended December 31st, 1899. The capital account shows an expenditure during the year of £8,620 5s. 4d., chiefly upon lands, machinery and

mains, making to December 31st last a total sum of £59,866 9s. 4d. The balance to credit of the net revenue account, including the balance brought forward, and after payment of interest charges and reserve for depreciation, is £1,522 8s. 6d. Out of this sum the directors recommend the payment of a dividend on the ordinary shares of the company at the rate of 4 per cent. for the year, less income-tax, which will absord £1,211 8s. 6d., leaving a balance of £311 to be carried forward. The equivalent of 14,256 8 c.p. lamps were connected to the company's mains at December 21st last, showing an increase equivalent to 1,904 8-c.p. lamps connected for the year. The County of London and Brush Provincial Electric Lighting Company's interests in the company have been taken over by the Bournemouth and Poole Electricity Supply Company, Limited, to whom the company is now indebted for the amount of its loan account. The sum of £850, received from the County of London and Brush Provincial Electric Lighting Company, Limited, in respect of an option over the unissued share capital of the company, has been appropriated to writing off the suspense account. A substantial reduction is to be made in the price of current and in the charges for meter rentals on and after March 31st, 1900. Mr. Aymor H. Sanderson and Mr. R. Percy Sellon have been appointed directors of the company. The retiring directors are Mr. A. H. Sanderson and Mr. R. Percy Sellon, who being eligible, offer themselves for re-election. The auditor, Mr. R. H. Marsh, also retires, and offers himself for re-election."

## Barcelona Tramways Company.

The directors' report for 1899, to be presented to the meeting in London on 21st inst., states:—

That the traffic receipts were £88,231, and sundry receipts £998, making £89,232. Deducting revenue charges, there is a balance profit of £5,132, with balance brought forward making £5 212, out of which the directors propose to apply £4,000 in payment of a dividend of 2 per cent., or 4s. per share, carrying over £1,212. The number of passengers carried was 21,736,264, compared with 14,801,528 in 1898. The traffic receipts were, from animal traction, £40,802, and from electric traction (part of year only), £47,432, together £88,234, an increase of £26,438. The working expenses in Spain and in England, including a loss of £7,350 on exchange, but excluding debenture and preference share charges and interest, amount to £66,018, against £55,887 an increase of £10,132. To this, however, the directors have added the loss of £5,413 on the sale of 486 mules, making the total expenses £71,431. The loss on exchange amounted to £7,350, against £2,418, owing solely to the increase of income, the rate itself having been slightly more favourable. To cover the cost of the conversion of the company's lines to electric traction, and to provide additional electric motor cars, the balance of the preference shares—namely, £70,000—and £48,100 of the 4½ per cent. debenture stock were issued. The expenses of the issue of debenture stock and 7,000 preference shares and the balance of cost of cars broken up and sold, in all £ 4,584 12s. 4d., have been placed to a suspense account, against which have been written off balance of premium on new shares, £8,508, and the £3,000 received for the option of purchase, together £11,508, leaving a balance of £8,074 to carry forward in suspense. The revenue of the Ensanche Company, although somewhat in excess of that for 1898, has, with the balance brought forward, not quite sufficed to cover working expenses, plus service of bonds, and the year closes with a debit balance of about £60. Permission to adopt electric traction on the Ensanche system will, it is hoped, be soon obtained. Electric traction commenced on January 26th, 1899, with five cars, was increased during February to 10 cars, and then gradually up to 73 in November, which is the number now running. In addition to the 85 motor cars originally estimated as sufficient, 40 more are expected to be running within the next few weeks. Mule traction will then entirely cease.

## Norwich Electric Tramways Company.

At the annual meeting of this company, says the *Railway World*, the following statements were issued in regard to the company's lines which are now under construction:—

Since the last ordinary general meeting was held on April 28th, 1899, further progress in the construction of the tramways has been made, but owing to unavoidable delays it was found impossible to complete them last autumn, as had been hoped. Nearly the whole of the permanent way (19 miles) is now completed. The overhead work is proceeding rapidly and satisfactorily, and there seems to be every probability that the contractors will fulfil their promise and complete this work by April 1st. At the power station work is in an advanced stage, the first of the engines is to be tested under steam to-day, and there is little doubt that the power station will be entirely completed by the time it is required, namely, by April 1st. Twenty out of 40 motor cars are on the ground and ready to run, and it is expected that the balance will be delivered during the month. Should the contractors finish their work as per contract on April 1st, there should be no difficulty in having the lines in full operation by the end of the month. The company has expended to date about £237,600 on tramways and street improvements, and about £75,000 is now due or further work done.

## The Eastbourne Electric Light Company, Limited.

The directors' report, submitted to the meeting held at Eastbourne on Monday, 12th inst., reads as follows:—

The shareholders have already been informed that the sale of the company's undertaking and works was duly completed on January 1st last, in accordance with the contract entered into with the Corporation in April, 1899. As a trading concern the company ceased its operations on December 31st last. The directors are arranging for the prompt realisation and distribution of the assets, with the view of winding up the company as quickly as possible. But it is necessary, in order to comply with the statutory obligations imposed upon the company by the Electric Lighting Acts, to prepare and submit to the shareholders the annual accounts for the year ended December 31st, 1899, and these are subjoined. The accounts show that the company has maintained the progressive success which has attended its operations in past years. The gross profit made for 1899 was £6,077 2s. 2d. The Corporation having agreed to refund the company all capital outlay made during 1899, it was unnecessary to debit revenue account with depreciation. The net result is that after providing for all interest on debentures and preference shares to December 31st, and for the interim dividends paid in 1899, a net profit for the year of £5,094 12s. 10d. has been realised. Out of this the directors propose that a dividend of 20 per cent. for the half-year ended December 31st last (making with the interim dividend paid in August £12 10s. per cent. per annum), free of income-tax, be paid on the ordinary share capital of the company. The estimated increase in the company's revenue, made on the negotiations for the sale of the undertaking to the Corporation has been amply justified, and the town may congratulate itself upon having secured a lucrative and valuable concern. The depreciation and reserve funds speak for themselves, but the directors point out that the balances to the credit of these funds have been largely absorbed in the over expenditure on capital account, and they are not therefore wholly available for distribution. There has already been distributed amongst the shareholders £20 on account of every £10 share fully paid, and £10 on account of each share upon which £5 has been paid. The result of the sale of the company's undertaking, as promised by the last annual report, has thus been secured to the shareholders. The directors have in preparation an approximate statement of the ultimate financial position of the company after all assets have been realised and liabilities settled. It is hoped that the shareholders will be well satisfied with the contents of the statement, which will be in their hands prior to the annual meeting.

At meetings held on 12th inst. the report was adopted, the chairman, Mr. G. Boulton, remarking upon the excellent results obtained during the year's working. Resolutions were passed voting £300 remuneration to the directors for the year, £1,000 as compensation to the manager and secretary (in addition to £2,000 paid by the Corporation), making altogether £3,000 to be divided, £2 000 to Mr. Wilkinson, and £1,000 to Mr. Towner (secretary). £1,000 was voted to the directors in recognition of their services to the company; £150 was voted for division among 17 men in the company's employ. The necessary resolutions for winding up were passed, Mr. Towner being appointed liquidator.

## The Pontypool Electric Light and Power Company, Limited.

The directors' report passed at the meeting held at Pontypool on March 8th, reads as follows:—

The directors beg to present to the shareholders a statement of the accounts of the company, together with the position of the undertaking at the end of the year 1899. During the year the mains of the company have been extended to the Town Hall, and the directors have free-wired that building, and made some further extensions on the premises of existing customers. The directors have entered into a contract with the Urban District Council to supply and maintain six arc lamps within the company's compulsory area. As will be seen from the accompanying account, the running of the station for the year ending December 31st, 1899, after carrying a sum of £100 to renewal account has resulted in a profit of £675 14s. 10d., which, after deducting debenture interest amounting to £214 4s. 8d., and adding the balance carried forward from last year, leaves a net profit of £474 14s. 4d.; of this the directors recommend that a sum of £50 be carried to the reserve account, that a sum of £150 be carried to the debenture redemption account, that a dividend of 5 per cent. be paid on the paid-up capital of the company, and the balance of £12 13s. 4d. be carried forward to next year. Mr. Howell having retired from the board, the directors elected Mrs. Clara A. Pegler a director in his stead. As it would be Mr. Howell and Mr. Ford's turn to retire from the board, Mrs. Pegler and Mr. Ford do so in accordance with the articles of association, but are eligible for re-election. The auditor (Mr. H. H. Haden) retires, but is also eligible for re-election.

## The Potteries Electric Traction Company, Limited.

The directors' report to be presented at the meeting to be held at Donington House, Norfolk Street, Strand, W.C., on Monday, March 19th, at 2 o'clock, reads as follows:—"The directors beg to submit their report and statement of accounts for the period from November 21st, 1898, to December 31st, 1899. The prospectus of the company was issued in November, 1898, and 20,000 ordinary shares and 20,000 5 per cent. cumulative preference shares of £10 each were allotted. The tramways of the North Staffordshire Company, about 6½ miles, were opened for working by electricity on May 16th last, and since then various sections of the extension tramways, about 6 miles, have been opened for traffic. The construction and equipment of the extension tramways and light railways are being pushed forward as rapidly as possible. A plan accompanies this report showing the extent of the lines open for traffic, and the state of progress made in the construction and equipment of the remainder. The total capital expenditure at December 31st, 1899, on account of construction of the permanent way and electrical equipment of the Potteries Extension Tramways and Potteries Light Railways including cost of Parliamentary powers and preliminary expenses, amounted to £275,085 18s. 9d. The company holds £73,400 first mortgage debenture bonds, £30,100 second mortgage bonds, 1,933 preference and 11,542 ordinary shares of the North Staffordshire Tramways Company, Limited, being 96 65 per cent. of the issued preference shares and 96·18 per cent. of the issued ordinary shares of that company and all the issued debentures with the exception of £20,000 first mortgage bonds. The directors propose to offer for subscription £125,000 4½ per cent. debenture stock, part of an authorised issue of £200,000. The gross profits for the period covered by the account amount to £20,884 8s. 11d., including the amounts received from the North Staffordshire Company for dividends and interest on the shares and debentures held by this company and in respect of the working agreement. After deducting all expenses chargeable to revenue, there remains a net profit of £10,949 16s. 3d. This amount the directors propose should be applied as follows, viz.:—

| | | |
|---|---|---|
| To provide for dividend on cumulative preference shares from August 15th to December 31st, 1899 .. .. .. .. | £3,750 | 0 |
| „ repayment to British Electric Traction Company of amount advanced for dividend on cumulative preference shares to August 15th, 1899, and income-tax thereon .. .. .. | 5,833 | 6 8 |
| „ transfer to the credit of a depreciation fund .. .. .. | 500 | 0 0 |
| „ be carried forward to the next account .. .. .. .. | 866 | 9 7 |
| | £10,949 | 16 3 |

Until a larger proportion of the lines is completed and opened for traffic it will not be possible to work the system with greater economy and efficiency, but the directors consider the results of the electrical working satisfactory and encouraging, having regard to the fact that during the whole period the system has been in a state of transition and incomplete. With a view to remove the complications of accounts arising out of the agreements made by the North Stafford-

shire Tramways Company prior to the formation of this company, the directors have made an agreement under which this company will collect all the traffic receipts, and will pay all the expenses in respect of the working of the North Staffordshire Tramways as from January 1st last, in consideration of the payment by this company of the debenture charges and a fixed dividend on the shares of the North Staffordshire Company. This agreement will be submitted to the general meeting for approval. The directors retiring this year are Mr. Emile Garcke and Major T. E. Pilkington, who are eligible for re-election. Messrs. Bourner, Bullock & Co., the auditors, also retire, and offer themselves for re-election.

LIABILITIES.

| | £ s. d. | £ s. d. |
|---|---|---|
| To share capital: | | |
| Authorised and issued— | | |
| 20,000 5 per cent. cumulative preference shares of £10 each, fully paid .. | 200,000 0 0 | |
| 20,000 ordinary shares of £10 each, fully paid | 200,000 0 0 | |
| | | 400,000 0 0 |
| „ Temporary loans on security of first mortgage debentures of the North Staffordshire Tramways Company, Limited— | | |
| Lloyds Bank, Limited .. .. .. .. | 22,000 0 0 | |
| The British Electric Traction Company, Limited .. .. .. .. .. .. | 10,000 0 0 | |
| | | 32,000 0 0 |
| „ Amount advanced by the British Electric Traction Company, Limited, for preference dividend (less tax) to August 15th, 1899 .. .. .. .. .. .. .. .. .. | | 5,638 17 9 |
| „ Sundry creditors .. .. .. .. .. .. .. .. | | 40,266 5 8 |
| NOTE.—A portion of this amount, claimed by contractors, is subject to arbitration. | | |
| „ Profit and loss account— | | |
| Profit to December 31st, 1899 .. .. .. | £10,949 16 3 | |
| Deduct—Preference dividend to August 15th, 1899 .. .. .. .. .. .. .. | 5,833 6 8 | |
| | | 5,116 9 7 |
| | | £483,021 13 0 |

ASSETS.

| | £ s. d. | £ s. d. |
|---|---|---|
| By Debentures of the North Staffordshire Tramways Company, Limited— | | |
| First mortgage bonds .. .. .. .. | 73,400 0 0 | |
| Second mortgage bonds .. .. .. .. | 30,100 0 0 | |
| | | 103,500 0 0 |
| „ Shares of the North Staffordshire Tramways Company, Limited— | | |
| 1,933 £10 preference shares at par .. . | 19,330 0 0 | |
| 11,542 £6 ordinary shares at £5 10s. per share | 63,481 0 0 | |
| | | 82,811 0 0 |
| „ Construction of the permanent way and electrical equipment of the extension tramways and light railways, Parliamentary powers, and preliminary expenditure .. .. .. | | 275,085 18 9 |
| „ Deposits— | | |
| Consols lodged with the Paymaster-General .. .. .. | | 6,221 0 0 |
| „ Stores and material .. .. .. .. .. .. .. | | 1,444 10 11 |
| „ Sundry debtors .. .. .. .. .. .. .. | | 9,221 10 0 |
| „ Cash— | | |
| At bankers .. .. .. .. .. .. | £4,623 10 11 | |
| In hand .. .. .. .. .. .. .. | 114 2 5 | |
| | | 4,737 13 4 |
| | | £483,021 13 0 |

PROFIT AND LOSS ACCOUNT FROM NOVEMBER 21ST, 1898, TO DECEMBER 31ST, 1899.

(Electrical running commenced on May 16th, 1899.)

| | |
|---|---|
| To Power and running expenses .. .. .. .. .. .. | £6,914 17 7 |
| „ Repairs and maintenance .. .. .. .. .. .. | 935 14 5 |
| „ Administration and general expenses .. .. .. .. .. | 1,446 16 10 |
| „ Interest on loans .. .. .. .. .. .. .. | 636 18 10 |
| „ Balance, carried to balance-sheet .. .. .. .. .. | 10,949 16 3 |
| | £20,884 8 11 |
| By Dividends and interest on shares and debentures of the North Staffordshire Tramways Company, Limited .. .. .. | £10,981 15 3 |
| „ Receipts from the North Staffordshire Tramways Company, Limited, under agreement for electrically running the cars | 6,021 17 6 |
| Other receipts in respect of traffic .. .. .. .. .. | 3,179 1 11 |
| Advertising receipts .. .. .. .. .. .. .. | 43 15 0 |
| Interest .. .. .. .. .. .. .. .. | 427 15 6 |
| Sundry receipts .. .. .. .. .. .. .. .. | 230 3 9 |
| | £20,884 8 11 |

## London United Tramways, Limited.

THE directors' report to be submitted at the general meeting of shareholders to be held at the offices of the company, Clare Street House, Bristol, on Saturday, March 17th, reads as follows:—"The directors have much pleasure in submitting herewith the statement of accounts for the year ending December 31st, 1899. The gross receipts for the period amounted to £54,368 14s. 8d., compared with £47,544 13s. 3d. for the previous year, an increase of £6,824 1s. 5d. The net profit amounts to £13,271 0s. 3d., which also represents a substantial increase of £2,641 6s. 4d. over that of 1898. It will be observed that additional capital has been expended during the year to the amount of £166,255, the whole of this sum being laid out upon the new works at present unproductive, but the directors have only transferred from the contingencies fund in respect of interest during construction the sum of £5,400, which is equivalent to the dividend upon £90,000 preference capital. These amounts, with the balance brought forward from the last account, give a total net revenue of £18,916 9s. 2d. to be dealt with. From this sum the directors have replaced £3,000 at the reserve fund for contingencies; debenture interest for the year and the interim dividends paid for the half-year to June absorb £8,325, and it is now proposed to declare final dividends of 6 per cent. per annum on the preference shares and of 10 per cent. per annum on the fully-paid ordinary shares, which together will appropriate £6,700, leaving a balance of £891 9s. 2d. to be carried forward to the credit of the new account. To meet the capital outlay the remainder of the authorised preference share capital has been issued during the year, and the premiums received have been carried to the contingencies fund. The total reserve funds now amount to £36,190. Very satisfactory progress has been made with the important works incident to the conversion of the system for electric traction, and the extension of the tramways. The erection of the central power station has been undertaken by the company without the intervention of a contractor, and contracts are in a forward state of execution for the steam and electrical equipment of the station and for 150 electric cars, the first instalment of the new rolling stock. The directors anticipate that the first portion, covering about 10 miles of tramways, will be operated by electric traction during the ensuing summer. The company's application for light railway extensions intended to bring the districts of Twickenham, Teddington, Hampton, and Hampton Wick into connection with the authorised electric system came before the Light Railway Commissioners in June last. The proposals were supported by the whole of the local authorities, but opposed by the London and South-Western Railway Company on the ground of competition, so that, while expressing themselves favourably towards the scheme, the Commissioners had no alternative, in view of the protection afforded the railway company by the Light Railways Act, but to decide that the scheme must be submitted to Parliament. Accordingly, a Tramway Bill is being promoted in the present session to authorise the Hampton Court extensions, and agreements have again been concluded with all the local authorities concerned, except the Teddington Council, who, whilst approving the tramways, and consenting for standing order purposes, seek now to impose conditions of so onerous a character, that the directors can confidently rely upon the decision of the Parliamentary Committee. Powers are also sought by the Bill for the authorisation of the connecting line between the existing tramway at Acton and the authorised lines at Hanwell, and agreements have at length been come to with the Ealing Council, as well as those of Acton and Hanwell, who supported the company's application on the former occasion. For the information of shareholders, a diagram is appended to this report, showing the authorised electric lines and the extensions included in the present Bill. The director retiring by rotation is Mr. Hugh C. Godfray, who offers himself for re-election. The auditor, Mr. Solomon Hare, also retires, and will be proposed for re-election. The dividends will be posted on March 19th inst."

## The Imperial Tramways Company, Limited.

THE report of the directors to be submitted at the meeting to be held at the Grand Hotel, Bristol, on Saturday, March 17th, reads as follows:—

The directors beg to submit the balance-sheet and general revenue account made up to December 31st last, together with details of revenue account of the subsidiary companies.

MIDDLESBROUGH, STOCKTON AND THORNABY ELECTRIC TRAMWAYS.—The operation of this important undertaking has been conducted with the greatest regularity and smoothness, and is highly appreciated by the populations of the three municipalities, the number of passengers carried in the 12 months being 8,307,322. The gross receipts have amounted to £45,372 13s. 8d., and the expenditure (including provision for depreciation and renewals) to £30,761 2s. 3d., leaving a net profit of £14,611 11s. 5d., representing as nearly as possible 6¾ per cent. upon the capital employed. The light railway extensions proposed at Middlesbrough were favourably entertained by the Commissioners, but arrangements have to be made with the owners of three toll gates and with reference to the railway crossings on the route, and so far it has been found impossible to arrive at any agreements; meanwhile the progress of the order remains in abeyance.

DARLINGTON TRAMWAYS.—The working of this tramway has resulted in a net profit for the year of £1,009 12s. 8d., and the amount appears at the credit of the revenue account. The Light Railway Commissioners have decided to grant the order for the proposed system of electric light railways to take the place of the existing horse line and more effectively serve the borough and district. Important details of the scheme remain to be agreed with the Corporation, however, before the order can be issued and the negotiations are still in progress.

LONDON UNITED TRAMWAYS, LIMITED.—The directors' report and accounts of this company are reprinted and annexed for the information of the shareholders. During the year the Imperial Company's interest in this undertaking has been increased by a further 15,000 6 per cent. preference shares, the capital for the purpose being provided by the issue of additional Imperial debenture stock. Of these shares 9,000 have borne dividend for the whole of the past year, but as the payment in respect of the 6,000 shares was only made at the close of the year, that number rank for dividend from the commencement of the present year. The amount received upon the Imperial Company's investments for the year 1899 has therefore been in respect of 13,000 preference shares, and at the improved rate of 10 per cent. upon the 4,000 ordinary shares.

READING TRAMWAYS COMPANY, LIMITED.—The traffic receipts of this company compare favourably with any former period, and the balance of revenue is sufficient for the payment of a dividend of 8 per cent. for the year upon the share capital, which is entirely held by the Imperial Company. The Corporation have recently given notice of a desire to acquire the company's undertaking upon terms of the Tramways Act, 1870, but the company dispute the legality of the proceeding, and are taking the necessary steps to prevent the Corporation from exercising the powers they claim. The company have also petitioned against a Bill being promoted by the Corporation in the present Session which, anticipating the acquisition of the company's undertaking, would authorise additional tramways and interference to which objection is taken.

CORRIS RAILWAY COMPANY.—The revenue for the year is slightly in excess of that of the preceding year, and with some saving in the expenditure, the net result is a dividend on the ordinary stock at the rate of 6 per cent., against 5 per cent. for 1898.

GENERAL.—It will be seen that the company's net revenue account for the year shows an available balance of £30,251 2s. 1d., and after payment of interest on the debenture stock and interim dividends on the preference and ordinary shares in respect of the half-year to June 30th last, amounting together to £18,875, it is proposed to appropriate the balance as follows:—In payment of dividend at 6 per cent. per annum on the preference capital, £8,000; final dividend at 8½ per cent. per annum on the ordinary capital, £8,500; and to carry forward to the next account the remaining sum, £376 2s. 1d. In addition, the reserve funds have been increased during the year from £47,824 to £69,203. Mr. Hugh C. Godfray, director, and Messrs. James Fraser & Sons, auditors, retire at the ensuing meeting, and will be proposed for re-election. The dividends will be posted on the 19th inst.

## The Brush Electrical Engineering Company, Limited.

THE eleventh report to be presented to shareholders at the general meeting at Cannon Street Hotel, E.C., on Monday, March 19th, at 12 o'clock noon, reads as follows:—"The directors herewith submit

and valuable concern. The depreciation and reserve funds speak for

accounts arising out of the agreements made by the North Stafford-



the balance-sheet and profit and loss account for the half-year ended December 31st, 1899, in accordance with the resolution of the shareholders at the annual meeting last September, to make the company's financial year terminate in future on December 31st in each year. The profit and loss account shows an available gross profit of £37,233 13s. 3d. After deducting maintenance, general charges, interest on debenture stock, and cost of issuing £75,000 perpetual second debenture stock, there remains a balance of net profit of £19,410 1s. 7d. The directors recommend that this sum be applied as follows:—

| | | | |
|---|---|---|---|
| To dividend at the rate of 6 per cent. per annum on preference shares for the half-year .. .. .. .. .. | £5,400 | 0 | 0 |
| „ dividend at the rate of 6 per cent. per annum on ordinary shares for the half-year .. .. .. | 5,400 | 0 | 0 |
| „ bonus payable to employés under profit-sharing scheme .. .. .. .. .. .. .. .. | 1,080 | 0 | 0 |
| „ depreciation reserve fund .. .. .. .. .. | 2,500 | 0 | 0 |
| „ balance carried forward .. .. .. .. .. | 5,010 | 1 | 7 |
| | £19,410 | 1 | 7 |

"Capital expenditure to the extent of £23,571 3s. 11d. has been incurred during the half-year on extensions of buildings and plant at Loughborough. The company's works are well filled with orders for steam engines, electric lighting and traction machinery, and tramway rolling stock. An issue of £125,000 4½ per cent. perpetual second debenture stock has been made during the half-year. Of this sum £75,000 was offered to and subscribed for by the public, the balance of £50,000 being reserved to enable holders of the existing redeemable second debenture stock to exchange their holdings for the new stock at par. Holders of redeemable second debenture stock to the amount of £33,710 have exercised this option, and notice has been given to the holders of the remaining £16,290 that they will be paid off at £105 per cent. on July 1st next. The directors regret to announce the death of their colleague, Mr. B. H. van Tromp, during the half-year under review. Mr. J. S. Raworth and Col. F. G. Steuart are the directors who retire by rotation, and being eligible, offer themselves for re-election. The auditors, Messrs. Cooper Bros. and Co., also retire, and offer themselves for re-election."

## The Dover Electricity Supply Company, Limited.

THE report of the directors, to be presented at the meeting at the offices, Park Street, Dover, on Wednesday, 21st inst., at 3 o'clock, reads:—

The directors beg to submit their report, with balance-sheet and accounts, for the year ended December 31st, 1899. The results for the year, in view of the increased cost of coal and other materials, may be regarded as very satisfactory. Exceptional attention has been paid to the efficient upkeep of the plant and buildings, which accounts for the increase in those items of expenditure, besides which, a sum of £500 has been placed to depreciation account. The directors are satisfied that the property and plant of the company is in the best possible state of efficient working, and is in a position to assure success to the enterprise of their shareholders, who may look for profits increasing year by year for many years. During the year applications have been received for an equivalent of 2,552 lamps, as against 2,407 in 1898, and the total output of the station has increased by 20 per cent. over the previous year. The directors have decided to offer consumers the choice of a fixed rate of charge for current for lighting purposes of 6d. per unit, or, at the consumers' option, the existing sliding scale system of charge, and to supply current for heating and power purposes at 2½d. per unit. These modified rates are resulting in a satisfactory increase of connections, and the use of electricity for heating and power purposes is extending, as its advantages for these purposes become realised. The gross profit for the year amounts to £2,739 9s. 4d. After paying debenture and other interest charges, there remains a balance of £1,325 13s. 11d., out of which the directors recommend the payment of a dividend at the rate of 3 per cent., which will absorb £1,313 11s. 8d., the balance being carried to the credit of suspense account. Since the last meeting, the remaining shares of the company have been allotted to existing shareholders. The steadily increasing business of the company will necessitate the issue of further capital in the near future, and this question is receiving the careful consideration of the board. The directors have to record, with regret, the death of their colleague Mr. B. H. Van Tromp. It is not at present proposed to fill the vacancy in the board thus created. The retiring directors are Mr. C. W. Bagshawe and Mr. R. Percy Sellon, who being eligible, offer themselves for re-election. The auditor, Mr. R. H. Marsh, chartered accountant, also retires, and is eligible for re-election.

## Oxford Electric Company, Limited.

THE annual meeting was held at Oxford on 3rd inst., Sir Henry C. Mance presiding.

In proposing the adoption of the report and accounts, the CHAIRMAN said that each year had been better than those which had gone before. After writing off £184 19s. 11d. on account of hire purchase installations, and a small amount from office furniture, they had the available sum of £3,573 10s, which they proposed to appropriate as follows: £2,500 in payment of a dividend on the ordinary shares of 5 per cent. per annum, and £1,000 to be added to the reserve and renewal of plant account, which would then amount to £1,750, leaving £73 10s. to be carried forward to next year's account. More than 3,600 8-C.P. lamps (or their equivalent) had been added to the system during the year. The result was no doubt largely due to the hire purchase system, which had been very popular. The increased demand for current in New College has rendered it desirable to establish an additional sub-station in the college. This has accordingly been done, and a second transformer and a set of storage batteries installed at Ship Street sub-station. They had only issued £2,350 of their debentures, so that to enable them to meet the capital expenses, some temporary assistance had been obtained from the bank; other debentures would be issued at their convenience, and when the time was more favourable than at present. The increase in the expenditure for coal was reasonable, considering the increased quantity of current generated. They had had to pay an increased price in consequence of the demands made for Welsh coal by the Government during the last two months of the year, and had, for prudence sake, been compelled to lay in a larger stock at an enhanced price. But the cost of coal, however, per the Board of Trade unit generated, compared favourable with that of the previous year, being ·63 of a 1d. as compared with ·65 of a 1d. in 1898. The efficiency of the system had also improved, being 74 per cent., or 2 per cent. higher than the year before. The maintenance charges were higher. The dynamo and transformer maintenance was responsible for the greater portion of the increase; several of the original transformer armatures had been entirely rewound and remodelled, their efficiency and capacity being thereby increased. The sales by meter had increased nearly 13 per cent. The additional consumers had been 83. They proposed to make a substantial reduction in the price for current. The maximum price would be reduced from 7d. to 6d. Such was their capacity, that if they were to run continuously they could manufacture enough electricity in three weeks to supply the whole of Oxford for a year. Besides having to meet the maximum demand, they had also to provide a certain margin of machinery to guard against breakdowns during the time of heavy load, and for this purpose they had just placed an order for an additional boiler and 225-KW. machine and engine, the whole of which will be placed in position during the coming summer.

The report was adopted.

## Newmarket Electric Light Company.

THE annual meeting of this company was held on Monday, Mr. G. H. Verrall presiding.

In moving the adoption of the directors' report and accounts, Mr. VERRALL said that the authorised capital was £30,000, and it had been decided to issue £15,000 in £10 shares, and £15,000 in 5 per cent. debentures. In the nine months ended December last they had made a profit of £99 16s. 5d., or £47 8s. 9d. less interest on debentures issued. They were now supplying over 2,000 8-C.P. lights, and had applications for nearly another 1,000. They were compelled to increase their plant to such an extent that they could double their output. Their prospects were, therefore, eminently satisfactory.

Mr. F. E. GRIPPER (of Messrs. Edmundsons, Limited), director, said there was every prospect of a substantial dividend being paid next year.

Two of the retiring directors, Messrs. B. Chennell and W. T. Pressland, were re-elected.

## Prospectus.

THE prospectus of the Buenos Ayres Electric Tramways Company, Limited, has been before the public this week. The company has been formed with a capital of £350,000 divided into 35,000 6 per cent. cumulative preference and 35,000 ordinary shares of £5. There is also £175,000 5 per cent. first mortgage debentures, part of a total first charge of £200,000. Subscriptions were invited for £175,000 debentures at 95 and 35,000 preference shares at par. Interest on these issues is guaranteed by the contractors for a period of two years, or until completion of the line to the satisfaction of the proper Government authority. The company took over the concession for a system of electric tramways granted to Mr. Charles Bright by the municipality of Buenos Ayres in August, 1898, and has acquired all the works already constructed, together with certain lands, buildings, rolling stock, machinery, &c., in connection therewith, and is to enter into contracts for the construction and completion of same. The company will pay the vendor and contractor a sum of £525,000 in 5 per cent. debentures, preference, and ordinary shares. The issues are made on behalf of Charles Bright and Co., Limited. Mr. C. J. Wharton, of Palace Chambers, S.W., is consulting engineer. The offices are at 68, Coleman Street.

**Stock Exchange Notices.**—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to Callender's Cable and Construction Company, Limited—further issue of 10,000 ordinary shares of £5 each; Fraser & Chalmers, Limited—further issue of £34,900 5 per cent. registered debentures of £100 each; and to allow the following securities to be quoted in the Official List:—Blackpool and Fleetwood Tramroad Company—further issue of 3,000 shares of £10 each, fully paid; Hove Electric Lighting Company, Limited—10,000 shares of £5 each, fully paid; Smithfield Markets Electric Supply Company, Limited—12,000 ordinary shares of £5 each, fully paid, Nos. 1 to 12,000 and £50,000 4 per cent. debenture stock. The committee has appointed special settling days as under:—Wednesday, March 21st, Brush Electrical Engineering Company, Limited—£108,710 4½ per cent. perpetual second debenture stock; Electric Lighting and Traction Company of Australia, Limited—20,000 6 per cent. cumulative preference shares of £5 each, £4 paid, Nos. 1 to 20,000. The committee has also ordered to be quoted in the Official List:—Brush Electrical Engineering Company, Limited—£108,710 4½ per cent. perpetual second debenture stock.—W. T. Henley's Telegraph Works Company, Limited—Further issue of 18,000 4½ per cent. preference shares of £5 each.

**Bury, Rochdale, and Oldham Tramway.**—The accounts of the Bury, Rochdale, and Oldham Tramway Company, Limited, for the half-year ended January 31st show a gross profit of £2,982, and the directors recommend distributions at the rate of £2 8s. 4d. per cent. per annum on the debenture bonds, and at the rate of 6 per cent. per annum on the shares. The sum of £500 is placed to reserve, and £23 carried forward.

issued during the year, and the premiums received have been carried to

12 o'clock noon, reads as follows:—"The directors herewith submit



**United Alkali Company.**—The report of the directors, to be submitted at the meeting to be held at Liverpool to-day, states that there is a net profit of £198,766, which is increased to £228,043, with £29,277 brought forward. An interim dividend on the preference shares at 7s. per share for the first half of the year has been paid, and the directors now recommend a dividend at the same rate, leaving £36,868 to carry forward.

**The Wireless Telegraph and Signal Company, Limited.**—An extraordinary general meeting of this company was held at 28, Mark Lane, E.C., on Wednesday, when resolutions changing the name of the company and altering Article No. 68, passed at the extraordinary meeting on February 23rd, were confirmed as special resolutions. Major S. Flood Page presided.

**Meetings.**—Yesterday (Thursday) meetings of the City of London Electric Lighting Company, the South London Electric Supply Corporation, and the Brompton and Kensington Electric Supply Company were held, but our reports are held over until next week, also our account of the meeting of Messrs. Davis & Timmins held on Wednesday.

**The Direct Spanish Telegraph Company, Limited.**—The board has decided to pay, in addition to the divided at the rate of 10 per cent. per annum on the preference shares, a dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended December 31st, 1899, and payable on April 1st next.

**County of London and Brush Provincial Electric Lighting Company.**—The directors recommend a dividend on the ordinary shares for 1899 at the rate of 4 per cent. per annum, after adding £10,500 to reserve for depreciation, repairs, and renewals, and carrying forward about £12,000.

**Scarborough Electric Lighting Company.**—At an extraordinary general meeting of this company on 8th inst. a resolution was confirmed creating £5,000 of new shares of £10 each, bringing the total capital of the company up to £100,000.

**Telegraph Manufacturing Company.**—The transfer books of the preference shares will be closed from 17th to 31st inst., both inclusive, for payment of the dividend for the half-year ended 31st inst.

**National Telephone Company.**—Letters of allotment for the issue of 100,000 ordinary shares of £5 each and the £500,000 4 per cent. debenture stock have been posted.

**Commercial Cable Company.**—A quarterly dividend of 1¾ per cent. on the capital stock is payable on April 14th.

## TRAFFIC RECEIPTS.

**Blackpool and Fleetwood Tramroad Company.**—The receipts for the week ending March 10th, 1900, were £182 2s. 2d.; receipts for corresponding period, 1899, £212 9s. 6d.; aggregate for half-year to date, £1,472 2s. 4d.

**The Bristol Tramways and Carriage Company, Limited.**—The receipts for the week ending March 9th, 1900, were £2,569 6s. 8d.; corresponding period, 1899, £2,459 15s. 0d.; increase, £109 11s. 8d.

**The City and South London Railway Company.**—The receipts for the week ending March 11th, 1900, were £1,303; ditto March 12th, 1899, £1,072; increase, £231. Total receipts for half-year, 1900, to date. £11,775; corresponding period, 1899, £11,143; increase £632. Miles open March 11th, 1900, 3¾; March 12th, 1899, 3½

**The Dover Corporation Tramways.**—The receipts for the week ending March 10th, 1900, were £141 10s. 8½d.; March 11th, 1899, £147 4s. 7d.; decrease, £5 13s. 10½d. Total receipts to date, 1900, £1,451 8s. 3½d.; corresponding period, 1899, £1,430 1s. 3d.; increase, £21 7s. 0½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,599; 1899, 4,314. Number of cars, 1900, 11; 1899, 11.

**The Dublin United Tramways Company.**—The receipts for the week ending Friday, March 9th, 1900, were as follows:—D. U. T. Co., horse cars, £46 19s. 1d.; ditto, electric cars, £2,784 5s. 11d.; D. S. D. Co., electric cars, £643 11s. 3d.; total, £3,474 11s. 3d.; corresponding week last year—D. U. T. Co., horse cars, £1,628 1s. 6d.; ditto, electric cars, £927 18s. 3d.; D. S. D. Co., electric cars, £625 9s. 3d.; total, £3,181 9s. 0d.; increase, £293 2s. 3d. Aggregate to date, £33,723 7s. 5d.; aggregate to date last year, £31,313 0s. 5d.; increase to date, £2,410 7s. 0d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

**The Halifax Corporation Tramways.**—The receipts for the week ending March 10th, 1900, were £588; week ending March 15th, 1899, £355; increase, £233. Number of cars, 1900, 28; 1899, 15. Total receipts to date, 1900, from April 1st, 1899, £28,648; ditto. 1899, from June 29th, 1898, £10,084. Miles of track open, 1900, 12; 1899, 6½.

**The Liverpool Overhead Railway Company.**—The receipts for the week ending March 11th, 1900, amounted to £1,869: corresponding week last year £1,864; increase, £5. Total increase in traffics for half-year to date, £1,319.

**The South Staffordshire Tramways Company.**—The receipts for the week ending March 9th, 1900, were £645 8s. 8d.; March 10th, 1899, £588 9s. 8d. Aggregate receipts for 10 weeks, £5,955 15s. 7d.; last year, £5,934 5s. 7d.

## STOCKS AND SHARES.

Wednesday Evening.

The wonderful interest which has been taken in the National War Loan issue has rather discouraged general business this week. Nearly everybody in the City appears to have applied for some of the scrip, and the demand upon the money market in consequence has had the effect of tightening rates to some extent. In the Stock Exchange it is contended that the revival of public interest in financial matters which is being stimulated by the War Loan cannot fail to bring about a more general tide of business when the disappointed applicants receive their money back—or part of it—from the Bank of England.

In the supply list the only recordable change is a fall of 10s. in the price of Metropolitan Electric shares, the old and new suffering equally. The market accounts for this weakness by the fact that the company's report induced the selling which has caused the price to fall. The report is not considered as satisfactory as it might be, and the company's constant bickering with the Marylebone Vestry has made some of the shareholders fidgety. St. James's and Pall Mall Ordinary are unaffected by the special settlement in the new shares which began on Tuesday. The two issues are now quoted in the Official List. By the way, intending investors in electrical supply shares would find it considerably cheaper if they were to buy new instead of old shares in those companies which have lately added to their capital. There is, of course, the question of marketability, on which ground the old shares score heavily, but if a buyer can afford to wait until the special settlement is fixed in the new shares, and they in a few months take rank with the old, he will find that a saving of from 5s. to 10s. a share can often be effected by purchasing the new issue instead of the old. As we have already said, the unmarketability of the former is greatly against them, but the removal of this disability is simply a matter of time, and investors in electrical supply shares are not of the kind who buy in order to snatch a small profit in a fortnight.

The telegraphic convention between Great Britain and France which was signed in Paris last month has now been formally approved, but its effect upon the stock markets is practically *nil*. Eastern Extension shares have again improved upon their quotation, and now stand at a relatively higher price than Eastern Telegraph Ordinary stock. The price of the latter shows no change, and on the contango-day the stock made up at 156½, which is the fraction below the contango price of the previous carry-over, 19 days before.

The making up list showed a curious inconsistency in the movements of the Anglo-American stocks during the Account. The Ordinary and the Deferred fell ½ and ⅜ to 64 and 14½ respectively, but the Preferred rose a point to 115½. There has been practically no change since the carry-over prices were fixed. Indo-European is being sought for, on the extension of the company's concession in Russia for another 20 years. For this the Russian Government will get a substantial *quid pro quo* in the shape of a largely increased proportion of the Indo-European's receipts, to say nothing of its having the disposal of the company's lines on Russian territory in the event of political complications arising.

Quite the feature of the week in the tramway market has been the rise in Dublin United shares, which advanced £4 in as many days. The Queen's visit to Ireland will, it is anticipated, yield the Dublin Company an enormous profit, since everyone in Ireland who can get to Dublin by any means whatsoever will undoubtedly make every effort to do so.

The Imperial Tramways report is chiefly interesting on account of the fight which it is announced that the directors will make against the Reading Corporation, which has given the company notice of a desire to acquire the company's undertaking, the latter resisting. The little Corris Railway, in Wales, which belongs to the Imperial Tramways, did better last year than it did in 1898, and the dividend on its stock is raised from 5 to 6 per cent. Another interesting report comes from the Barcelona Tramways Company, whose £10 Ordinary shares stand at 13½. Electric traction was commenced on the line in January, 1899, with five cars. In November the number had been raised to 73, mule traction, the directors' hope, will soon be abandoned altogether. Anglo-Argentine shares are a thought harder on the dividend declaration, but the price seems unable to get away from 4, to which it has clung for months.

The Buenos Ayres Electric Tramways Company, Limited, is the title of the latest candidate for public support. It was formed to take over the concession for a system of electric tramways, granted to a Mr. Charles Bright by the municipality of Buenos Ayres in August, 1898. The company has a capital of £350,000 divided into Ordinary and 6 per cent. Preference shares, the latter of which are now offered for subscription, as well as a 5 per cent. Debenture issue at 95, repayable in 1935 at 105.

City and South London Ordinary has again improved a brace of points, and buyers paid 68 for the stock early in the week. The buying is inspired by the hopes of what the new extension to Moorgate Street will do for the company, but we are afraid the bulls are a little premature on their hopes, and that the benefit to the City and South London will not be quite so much as they are expecting. Central Londons show no change, and Waterloo and City have once more relapsed into quietude.

consequence of the demands made for Welsh coal by the Government during the last two months of the year, and had, placed to reserve, and £23 carried forward.



## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1897. | 1898. | 1899. | Closing Quotation, March 7th. | Closing Quotation, March 14th. | Business done during week ended March 14th, 1900. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 110,900 | African Direct Telegraph, 4 % Debs. ... ... ... | 100 | ... | ... | ... | 99 —103 | 99 —103 | ... | ... |
| 25,000 | Amazon Telegraph, shares ... ... ... ... ... | 10 | ... | ... | ... | 3 — 4 | 3 — 4 | ... | ... |
| 125,000 | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | ... | ... | ... | 85 — 90 | 85 — 90 | ... | ... |
| 875,520 | Anglo-American Telegraph ... ... ... ... ... | Stock | 3 % | £3 9s | 73/6 | 63 — 66 | 63 — 66 | 64⅛ | 63 |
| 3,062,240 | Do. do. 6 % Pref. ... ... ... | Stock | 6 % | 6 % | 6 % | 114½—11'½ | 115 —116 | 116 | 115 |
| 3,062,240 | Do. do. Deferred... ... ... ... | Stock | ... | 18s. % | £1 7s | 14¼— 14⅜ | 14 — 14½ | 14 5/16 | 14⅛ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 ... ... ... ... | 5 | 4 % | ... | ... | 2 — 3 | 2 — 3 | ... | ... |
| 10,000,000$ | Commercial Cable ... ... ... ... ... ... | $100 | 8 % | 8 % | ... | 165 —175 | 165 —175 | ... | ... |
| 1,332,323£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 103 —105 | 103 —105 | 104½ | 103½ |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 1¼ % | 1 % | ... | ¼— ¼ | ¼— ¼ | ... | ... |
| 16,000 | Cuba Telegraph ... ... ... ... ... ... ... | 10 | 7 % | 8 % | ... | 9 — 10 | 9 — 10 | 9⅞ | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... | 10 | 10 % | 10 % | ... | 19 — 20 | 19 — 20 | 19⅞ | 19¾ |
| 12,981 | Direct Spanish Telegraph ... ... ... ... ... | 5 | 4 % | ... | ... | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... | 5 | 10 % | ... | ... | 9 — 10 | 9 — 10 | 9⅞ | ... |
| 30,000 | Do. do. 4½ % Debs. ... ... ... | 50 | ... | ... | ... | 101 —105% | 101—105% | ... | ... |
| 60,710£ | Direct United States Cable ... ... ... ... ... | 20 | 3½% | 3½% | 3 % | 11½— 12 | 11½— 12 | 11 11/16 | ... |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. ... ... | 100 | ... | ... | ... | 99 —102 | 99 —102 | ... | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock ... ... ... | Stock | 7 % | 7 % | ... | 155 —160 | 155 —160 | 157½ | 155 |
| 1,795,000 | Do. 3½% Pref. Stock ... ... ... | 100 | ... | ... | ... | 98 —101 | 98 —101 | 100⅜ | 99 |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | ... | ... | 116 —121 | 116 —121 | ... | ... |
| 250,000 | Eastern Extension, Australasia, and China Telegraph ... | 10 | 7 % | 7 % | ... | 15¾— 16¼ | 16 — 16½ | 16½ | 15⅞ |
| 16,200£ | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | ... | ... | 101 —103 | 100 —103 | ... | ... |
| 64,400£ | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | ... | ... | 100 —103 | 100 —103 | 100½ | ... |
| 320,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | ... | ... | 115 —120 | 115 —120 | 116 | ... |
| 300,000£ | Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909 | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 200,000£ | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000 | 25 | ... | ... | ... | 101 —104% | 101 —104% | ... | ... |
| 180,227 | Globe Telegraph and Trust ... ... ... ... | 10 | 4½% | 5½% | ... | 11¼— 12 | 11¼— 12 | 11 3/8 | 11⅜ |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % | 6 % | ... | 15½— 16 | 15½— 16 | 15⅝ | 15⅜ |
| 150,000 | Great Northern Telegraph, of Copenhagen... ... ... | 10 | 10 % | ... | ... | 31 — 33 | 31 — 33 | 32⅛ | ... |
| 86,300 | Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 99 —102 | 99 —102 | ... | ... |
| 17,000 | Indo-European Telegraph ... ... ... ... ... | 25 | 10 % | 10 % | ... | 50 — 54 | 50 — 54 | 53½ | 52 |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. ... ... | 100 | 6 % | ... | ... | 104 —107 xd | 104 —107 | ... | ... |
| 72,680 | Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ... | 1 | ... | ... | ... | ¼— ⅜ | ¼— ⅜ | ... | ... |
| 86,492 | Do. do. 5% Pref., Nos. 1 to 86,492 | 1 | 4 % | 4 % | 2½ % | ¾— 1 | ¾— 1 | ... | ... |
| 490,000 | National Telephone, 1 to 490,000 ... ... ... ... | 5 | 6 % | 6 % | 5 % | 5 — 5¼xd | 5 — 5¼ | 5 1/16 | 5 1/16 |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 14 — 15 xd | 14 — 15 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 14 — 15 xd | 14 — 15 | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 6 % | 5¼— 5¼xd | 5¼— 5¼ | 5⅜ | ... |
| 1,329,471£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½ % | 3½ % | 3½% | 97 —100 | 97 —100 | 98⅜ | 97 |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | ... | ¾— 1 | ¾— 1 | 1 1/16 | ⅞ |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ... | 100 | 4 % | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 11,839 | Reuter's ... ... ... ... ... ... ... ... | 8 | 5 % | ... | ... | 7 — 8 | 7 — 8 | 7¼ | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 126 —131 | 126 —131 | 127 | 126⅜ |
| 58,000 | United River Plate Telephone ... ... ... ... | 5 | 5 % | 6 % | 6 % | 4⅜— 5⅛ | 4⅜— 5⅛ | 5 1/16 | 4 15/16 |
| 16,639 | Do. do. 5 % Cum. Pref. Nos. 1—16,639 | 5 | ... | ... | ... | 4⅜— 5⅛ | 4⅜— 5⅛ | ... | ... |
| 179,947 | Do. do. 5 % Debs. ... ... ... | Stock | .. | ... | ... | 103 —106 | 103 —106 | 104 | ... |
| 200,000£ | West African Telegraph, 5 % Debs. ... ... ... ... | 100 | % | ... | ... | 96 — 99 xd | 96 — 99 | ... | ... |
| 80,008 | West Coast of America, Nos. 1—80,000 and 53,001—53,008 | 2½ | ... | ... | ... | ¼— 1 | ¼— 1 | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel. | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 389,731 | Western and Brazilian Telegraph 4 % Deb. Stock Red. ... | Stock | ... | ... | ... | 00 —104 | 100 —104 | ... | ... |
| 205,993 | Western Telegraph, Ltd., Nos. 1—205,993 ... ... ... | 10 | ... | ... | ... | 14⅜— 15⅛ | 14⅜— 15⅛ | 15 1/16 | 14⅝ |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1906 ... | 100 | ... | ... | ... | 106 —109 | 106 —109 | ... | ... |
| 88,321 | West India and Panama Telegraph ... ... ... ... | 10 | £% | ... | ... | ⅞— 1⅛ | ⅞— 1¼ | 1⅛ | 1 1/16 |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. ... | 10 | 6 % | ... | ... | 9½— 9⅝ | 9½— 9⅝ | ... | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. ... | 10 | 6 % | ... | ... | 7 — 8 | 7 — 8 | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 158,100£ | Western Union of U.S. Telegraph, 6 % Ster. Bonds ... | 100 | 6 % | ... | ... | 97 —102 xd | 100 —104 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19,661 | Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761 | 5 | 4 % | 6 % | ... | 7 — 8 | 7 — 8 | 7⅝ | ... |
| 12,000 | Do. do. 7 % Cum. Pref. ... | 5 | 7 % | ... | ... | 8½— 9½ | 8½—9½ | ... | ... |
| 80,000 | Charing Cross and Strand Electricity Supply ... ... | 5 | 7 % | 8 % | 9 % | 9½— 10½ | 9 — 10 xd | ... | ... |
| 20,000 | Do. do. do. do. Nos. 30,001—50,000 | 5 | ... | ... | ... | 9 — 10 | 9 — 10 xd | ... | ... |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | ... | ... |
| 84,000 | *Chelsea Electricity Supply, Ord., ... ... ... ... | 5 | 6 % | 6 % | 6 % | 7 — 8 | 7 — 8 xd | 7⅞ | ... |
| 100,000 | Do. do. do. % Deb. Stock Red.... | Stock | 4½% | ... | .. | 110 —112 | 110 —112 | ... | ... |
| 60,000 | City of London Electric Lighting, Ord. 40,001—100,000 ... | 10 | 10 % | 6 % | 4 % | 9½— 10½ | 9½— 10½ | 10 | 9½ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 ... ... ... | 10 | 6 % | 6 % | ... | 13 — 14 | 13 — 14 | 13⅝ | 13½ |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | ... | ... | 122 —127 | 122 —127 | ... | ... |
| 40,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000 | 10 | nil | nil | 4 % | 9½— 10½ | 9½— 10½ | 10½ | 10 |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | ... | 12½— 13½ | 12½— 13½ | 13½ | ... |
| 200,000 | Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. | ... | ... | ... | ... | 109 — 112 | 109 —112 | 110 | 109 |
| 26,100 | Edmundsons Elec. Corp., Ord. Shares ... ... ... | 5 | 5 % | 7 % | ... | 4⅜— 5½ | 4⅜— 5½ | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. ... | 3 | ... | ... | ... | 1⅜— 2¼ | 1⅜— 2¼ | 1 1/16 | ... |
| 48,050 | Do. do. do. 6 % Pref. | 5 | ... | 6 % | ... | 4½— 5 | 4½— 5 | ... | ... |
| 100,000 | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 101 —103 | 100 —102 | ... | ... |
| 62,500 | Metropolitan Electric Supply, 101 to 62,500 ... ... | 10 | 6 % | 5 % | 5 % | 14 — 15 | 13½— 14½ | 13 15/16 | 13½ |
| 22,500 | Do. Nos. 62,501 to 85,000 ... ... ... | 10 | ... | ... | ... | 14 — 15 | 13½— 14½ | ... | ... |
| 220,000£ | Do. 4½ % First Mortgage Debenture Stock | ... | 4½% | ... | ... | 114 —117 | 114 —117 | ... | ... |
| 125,000 | Do. 3½ % Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 95 — 97 | 95 — 97 | ... | ... |
| 6,452 | Notting Hill Electric Lighting ... ... ... ... | 10 | 6 % | 6 % | 7 % | 16 — 17 | 15½— 16½xd | ... | ... |
| 31,980 | St. James's and Pall Mall Electric Light, Ord. ... ... | 5 | 14½% | 14½% | 14½% | 14½— 15½ | 14½— 15½ | 14⅞ | 14½ |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 8½— 9½ | 8½— 9½ | 8⅝ | ... |
| 65,000 | South London Electricity Supply, Ord. ... ... ... | 5 | ... | ... | ... | 3⅝— 4¼ | 3⅝— 4¼ | ... | ... |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 ... | 5 | 12 % | 12 % | 13 % | 13½— 14½xd | 13½ — 14½ | 14 | ... |

* Subject to Founder's Shares. ‡ Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. † Dividends paid in deferred share warrants, profits being used as capital
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Loan issue has rather discouraged general business this week. Nearly everybody in the City appears to have applied for some of the scrip, more relapsed into quietude.



## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last three years. 1897. | 1898. | 1899. | Closing Quotation Mar. 7th. | Closing Quotation Mar. 14th. | Business done week ended Mar. 14th, 1900. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| | | ‡ | | | | | | | |
| 65,000 | Aluminium shares, Nos. 1—65,000 ... ... ... ... | 1 | 10 % | ... | ... | 2¾— 3¼ | 2¾— 3¼ | 3⅛ | ... |
| 90,000 | Do. 4½ % 1st Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 97 —102 | 97 —102 | 100 | ... |
| 80,000 | British Electric Traction ... ... ... ... ... | 10 | ... | 6 % | ... | 17 — 18 | 17 — 18 | 17⅝ | 17½ |
| 30,000 | Do. do. 6 % Cum. Pref. 30,001—60,000 | 10 | ... | ... | ... | 13½— 13⅝ | 13 — 13½ | 13⅛ | ... |
| 200,000 | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 126 —129 | 126 —129 | ... | ... |
| 45,000£ | †British Electric Works Co., Ord. £1 shares, 50,001—95,000 | ... | ... | ... | ... | 1/16— 1 1/16 | 1/16— 1 1/16 | ... | ... |
| 50,000 | † Do. do. 6 % Cum. Pref., 1—50,000 ... | ... | ... | ... | ... | ⅞— 1 | ⅞— 1 | ... | ... |
| 500 | † Do. do. 4½ % 1st Mort. Deb. ... ... | 100 | ... | ... | ... | 99 —101 | 99 —101 | ... | ... |
| 40,000 | British Insulated Wire Ord., Nos. 1 to 40,000 ... ... | 5 | ... | ... | 20 % | 11 — 12 | 11 — 12 | ... | ... |
| 27,500 | Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ... | 5 | ... | ... | ... | 5⅝— 6¼ | 5⅝— 6¼ | ... | ... |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... ... | 3 | 3 % | 5 % | ... | 1⅞— 2⅛ | 1⅞— 2⅛ | 1 15/16 | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | 6 % | 6 % | ... | 2¼— 2½ | 2¼— 2½ | 2⅝ | 2½ |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 108 —113xd | 108 —113 | ... | ... |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 20,000 | Callender's Cable Construction shares, Nos. 1—20,000 ... | 5 | 12½ % | 15 % | ... | 14 — 15 | 14 — 15 | 14⅞ | ... |
| 20,000 | Do. do. 5 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | 5⅝ | ... |
| 90,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | ... | ... | ... | 111 —115 | 111 —115 | ... | ... |
| 213,533 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9⅞— 10¼ | 9⅞— 10¼ | 10¼ | 10⅛ |
| 61,033 | Do. do. Pref. half-shares ... ... | 5 | ... | ... | ... | 4⅞— 5⅛ | 4⅞— 5⅛ | ... | ... |
| 71,447 | Do. do. Def. do. ... ... ... | 5 | ... | ... | ... | 4⅞— 5⅛ | 4⅞— 5⅛ | ... | ... |
| 855,000 | City and South London Railway ... ... ... ... | Stock | 1¼ % | 2¼ % | 1¼ % | 61 — 64 | 64 — 68 | 67 | 64 |
| 37,000 | Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd. | 10 | ... | ... | ... | 4 — 5 | 4½— 5½ | 5¼ | 5 |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 3½— 4 | 3½— 4 | ... | ... |
| 100,000 | Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | ... | ... | ... | ... | 98 101 | 98 —101 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 6 % | 6 % | ... | 2 — 2½ | 2 — 2½ | 2 1/16 | ... |
| 17,189 | Do. do. do. "A" Shares, 01—017,189 | 5 | 6 % | 6 % | ... | 3½— 4½ | 3½— 4½ | ... | ... |
| 344,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 93 — 95 | 93 — 95 | 93½ | ... |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... ... | 2 | 6 % | 6 % | ... | 2¼— 2⅜ | 2¼— 2⅜ | ... | ... |
| 25,000 | Do. do. 7 % Cum. Pref., 1 to 25,000 ... | 2 | 7 % | 7 % | ... | 2⅜— 3¼ | 2⅜— 3¼ | ... | ... |
| 140,300 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅜— ⅝ | ⅜— ⅝ | ... | ... |
| 9,600£ | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | 7 % | ... | 10 — 12 | 10 — 12 | ... | ... |
| 30,000 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 5 | 12 % | 14 % | ... | 14 — 15 | 13½— 14½xd | 14½ | ... |
| 12,000 | Do. do. do. 4½ % Pref. ... ... | 5 | 7 % | 7 % | ... | 5½— 6 | 5½— 5⅝xd | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½ % | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | ... | 21 — 22 | 21 — 22 | 21½ | 21¼ |
| 800,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 100 —104 | 101 —105 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 3½ % | 3½ % | 3⅜ % | 9¼— 9⅝ | 8⅝— 8⅞ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 13 — 13½ | 12⅞— 13⅜ | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 15 % | 37 — 41 | 36 — 40 xd | 39 | 38 |
| 150,000 | Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 20,000 | Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ... | 5 | ... | ... | ... | 9 — 10 | 9 — 10 | 9½ | ... |
| 20,000 | Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ... | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | 5⅝ | ... |
| 540,000£ | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | 3 % | 3 % | 101 —104 | 101 —104 | ... | ... |

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

## LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 101—104.
National Electric Free Wiring, 12/6 paid. ¼—⅛.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10¼—10½.
Smithfield Market Electric, 2—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7⅛—8. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18.

* From Birmingham Share List.

**Bank rate of discount 4 per cent. (January 25th, 1900).**

## MARKET QUOTATIONS, Wednesday, March 14th.

| CHEMICALS, &c. | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| g Acid, Hydrochloric .. .. | per cwt. | 5/- | 5/- | .. |
| a " Nitric .. .. .. | per cwt. | 22/- | 22/- | .. |
| a " Oxalic .. .. .. | per cwt. | 32/- | 32/- | .. |
| a " Sulphuric .. .. .. | per cwt. | 5/6 | 5/6 | .. |
| a Ammoniac, Sal .. .. .. | per cwt. | 40/- | 40/- | .. |
| a Ammonia, Muriate (crystal) .. | per ton | £29 | £29 | .. |
| a " " " .. .. | per ton | £27 | £27 | .. |
| a Bleaching powder .. .. | per ton | £7 | £7 | .. |
| a Bisulphide of Carbon .. .. | per ton | £15 | £15 | .. |
| a Borax .. .. .. .. | per ton | £16 10 | £16 10 | .. |
| a Bensole (90 %) .. .. .. | per gal. | 7/- | 7/- | .. |
| a " (50/90 %) .. .. | per gal. | 5/6 | 5/6 | .. |
| a Copper Sulphate .. .. .. | per ton | £25 | £25 | .. |
| a Lead, Nitrate .. .. .. | per ton | £25 | £25 | .. |
| a " White Sugar .. .. | per ton | £31 | £31 | .. |
| a " Peroxide .. .. .. | per ton | £27 10 | £27 10 | .. |
| a Methylated Spirit .. .. | per gal. | 2/9 | 2/9 | .. |
| a Naphtha, Solvent (90 % at 160° C.) .. .. .. .. | per gal. | 5/6 | 5/6 | .. |
| a Potash, Bichromate, in casks.. | per lb. | 4½d. | 5d. | ¾d. dec. |
| a " Caustic (75/80 %) .. | per ton | £24 | £24 | .. |
| a " Bisulphate .. .. | per ton | £25 | £25 | .. |
| a Shellac .. .. .. .. | per cwt. | 68/- | 68/- | .. |
| a Sulphate of Magnesia .. .. | per ton | £4 10 | £4 10 | .. |
| a Sulphur, Sublimed Flowers .. | per ton | £6 | £6 | .. |
| a " Recovered .. .. | per ton | £5 10 | £5 10 | .. |
| a " Lump .. .. .. | per ton | £5 | £5 | .. |
| a Soda, Caustic (white 70 %) .. | per ton | £10 15 | £10 15 | .. |
| a " Crystals .. .. .. | per ton | £3 | £3 | .. |
| a " Bichromate, casks .. | per lb. | 3½d. | 4¼d. | ¾d. dec. |
| **METALS, &c.** | | | | |
| Aluminium Wire, in ton lots .. | per ton | £224 | £224 | .. |
| b " Sheet, in ton lots.. | per ton | £191 | £191 | .. |
| p Babbitt's metal ingots .. .. | per ton | £85 to £165 | £85 to £145 | inc. |
| c Brass (rolled metal 3" to 12") basis | per lb. | 8d. | 8d. | .. |
| c " Tube (brazed) .. .. | per lb. | 10d. | 10d. | .. |
| c " " (solid drawn) .. | per lb. | 9d. | 9d. | .. |
| c " Wire, basis .. .. | per lb. | 8½d. | 8½d. | .. |
| c Copper Tubes (brazed) .. .. | per lb. | 11¾d. | 11¾d. | .. |
| c " " (solid drawn) .. | per lb. | 11¾d. | 11¾d. | .. |
| g Copper Bars (best selected) | per ton | £88 | £88 | .. |

| METALS, &c. (*continued*). | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| g Copper Sheet .. .. .. | per ton | £88 | £88 | .. |
| g " Rod .. .. .. | per ton | £88 | £88 | .. |
| c " (Electrolytic), Bars .. | per ton | .. | £85 | .. |
| c " " Sheets.. | per ton | .. | £94 | .. |
| c " " Rod .. | per ton | .. | £88 | .. |
| c " " H. C. wire | per lb. | .. | 10d. | .. |
| f Ebonite Rod .. .. .. | per lb. | 3/- | 3/- | .. |
| f " Sheet .. .. .. | per lb. | 5/- | 5/- | .. |
| n German Silver Wire .. .. | per lb. | 1/6 | 1/6 | .. |
| h Gutta-percha, fine .. .. | per lb. | 8/- | 8/- | .. |
| h India-rubber, Para fine .. | per lb. | 4/3½ | 4/5 | 1½d. dec. |
| i Iron, Charcoal Sheets .. .. | per ton | £18 | £18 | .. |
| i " Pig (Cleveland warrants) | per ton | 72/- | 70/- | 2s. inc. |
| i " Forgings, according to size | per ton | From £11 | From £11 | .. |
| i " Scrap, heavy .. .. | per ton | 70/- to 72/6 | 70/- to 72/6 | .. |
| i " Wire galvanised No. 8 .. | per ton | £14 5 | £14 5 | .. |
| g Lead, English Ingot .. .. | per ton | £16 15 6 to £16 17 6 | £16 11 3 to £16 13 9 | inc. |
| g " " Sheet .. .. | per ton | £18 | £18 | .. |
| m Manganin Wire No. 28.. .. | per lb. | 8/- | 8/- | .. |
| g Mercury .. .. .. .. | per bottle | £9 12 6 | £9 12 6 | .. |
| d Mica (in original cases), small | per lb. | 3d. to 9d. | 3d. to 9d. | .. |
| d " " " medium | per lb. | 1/9 to 2/9 | 1/9 to 2/9 | .. |
| d " " " large | per lb. | 3/3 to 7/3 | 3/3 to 7/3 | .. |
| p Phosphor Bronze, plain castings | per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| p rolled bars & rods | per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| p " r'l'd str'p & sheet | per lb. | From 1/3 | From 1/3 | .. |
| c Platinum .. .. .. .. | per oz. | £3 12 | £3 11 | 1s. inc. |
| p Silicium Bronze Wire .. .. | per lb. | 10½d. to 1/ | 10½d. to 1/- | .. |
| i Steel, Magnet, acc'd'g to desc'p'n | p. ton | From £15 to £40 | to £40 | .. |
| i Steel, Magnet, in bars .. .. | | £58 | £58 | .. |
| g Tin, block .. .. .. .. | per ton | £143 to £144 nom. | £152 to £153 nom. | £9 dec. |
| g " foil .. .. .. .. | per lb. | 1/9 | 1/9 | .. |
| n " wire Nos. 1 to 16 .. .. | per lb. | 1/11 | 1/11 | .. |
| p White Anti-friction Metals— | | | | |
| "White Ant" brand .. | per ton | £40 to £70 | £40 to £70 | .. |
| f Yarns, Cotton, Single 10lb. bundles | pr lb. | 8¼d. | 8¼d. | .. |
| f " Best Flax, 6 lea. .. | per lb. | 5½d. | 5½d. | .. |
| f " Hemp, 3 ply 10 lbs. .. | per lb. | 4½d. | 4½d. | .. |
| f " " Russian, 10 lbs. | per lb. | 5⅝d. | 5½d. | .. |
| f " Jute, 180 lbs. rove .. | per ton | £15 | £15 | .. |
| k Zinc, Sheet (Vielle Montagne bnd.) | p.t. | £27 5 nett. | £27 5 nett. | .. |

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry G. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

Unless otherwise stated all shares are fully paid. § Dividend is paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.



## INSTITUTION OF ELECTRICAL ENGINEERS.

### ON THE APPLICATIONS OF ELECTRICITY IN MEDICAL AND SURGICAL PRACTICE.

By H. Lewis Jones, M.D., Medical Officer in charge of the Electrical Department in St. Bartholomew's Hospital.

(*Paper read March 8th*, 1900.)

It was with very great pleasure that I received a communication from your President last autumn, asking me to write you a paper on "Medical Electricity." And it is a pleasure to me for several reasons; first, because it is a recognition by the Institution of Electrical Engineers of the existence of their somewhat humble sister medical electricity; secondly, because it gives me an opportunity of putting on record the position which medical electricity holds at the end of the nineteenth century; and thirdly, because I hope to be able to give you some information which may be new to you.

To a certain extent there is a correspondence between the work of an engineer in the repairing shop and that of a medical man in his practice; and this was brought quite forcibly to my mind a little while ago, when I had occasion to write and ask a member of the Institution kindly to come and advise me with regard to a motor which was in feeble health. When he came, he said that he had been sitting up all night with an engine which was on the point of breaking down. It seemed to me to be closely the kind of work which the medical man is often called on to do, substituting only the human being for the machine.

The medical side of electricity has been prominent from the early days of the science. Its physiological effects were among the first observations made. In particular, the experiments of Aldini upon the muscles of recently killed animals seem to have created a deep impression upon the people of his day, and to have held out hopes of the discovery in electricity of valuable healing properties.

Electrical departments were in existence in some of the London Hospitals a hundred years ago. At St. Thomas's in 1799, the electrical department was under the charge of a surgeon, Mr. Birch, who has left a very interesting "Letter on Medical Electricity," which is printed in a book called "An Essay on Electricity," by George Adams. The copy of this work which I possess is the third edition, printed in 1799, and having for frontispiece a woodcut representing a medical man applying electricity in a manner which clearly shows considerable scientific knowledge. As some of those present may not have seen it, I have brought down the woodcut, and it lies on the table here for inspection. Among other interesting observations of Mr. Birch, there is one which may cause us to smile, or rather to sigh, at the change between his times and ours. The surgeon writes, "The ingenuity with which these simple modes of application may be varied, to puzzle and deceive the observation of a bystander, is unbounded, and would have formed a grand basis for empiricism if they had been artfully employed; but as electricity has escaped abuses I trust," &c., &c.

John Freke, F.R.S., who was elected surgeon at St. Bartholomew's in 1729, is incidentally referred to in Fielding's well-known novel, "Tom Jones," as an authority on the subject of medical electricity.

It is now 150 years since the beginning of medical electricity. During the whole of that time it has had to fight its way in the face of many difficulties, and the most serious of these has been the passive resistance of medical men themselves. The vitality which the subject has shown under adverse circumstances is most significant. Medical electricity advances steadily, and the progress during the last decade has been very great. The commercial application of electricity and its house to house distribution by electric lighting companies have called into existence a large number of new instruments and new methods of treatment, and are helping the spread of the study of medical electricity by simplifying the means of obtaining the current when required. The accumulator has been of great service by affording a trustworthy source of currents for the use of surgeons in their galvano-cauteries and exploring lamp instruments. The discovery of the X rays, and their application to surgery and medicine, have also done good to the cause of medical electricity by bringing electrical apparatus into more extended use, and the founding of X ray departments in hospitals gradually leads to the development of electro-therapeutic departments in places where these are not already in existence. Most of the London hospitals now have electrical departments, and these are of manifest utility. At St. Bartholomew's Hospital we have about 600 cases referred yearly to the electrical department from all quarters of the hospital, exclusive of the cases for X ray photography, the numbers of which are even greater. And the results of our treatment will compare favourably with those in any other branch of medical practice.

It is a little difficult to speak on a medical subject before a non-medical audience without incurring the suspicions of those who are always on the alert for signs of unprofessional behaviour, and there is no branch of medical practice upon which the fierce light of criticism shines more sharply than upon medical electricity. I shall therefore have nothing to say on such matters as the relation of cases, statements of cures, and so forth, which might be thought to be unsuitable to my audience, but will try to meet you on the common ground of apparatus and methods, and in particular I shall try to lay before you some of the difficulties and problems which arise in the course of our medical work, in the hope that some of them may be solved by the advice and suggestions of those who are here present.

From conversations which I have had at various times with engineering friends, I am disposed to think that the number and extent of the applications of electricity to medical practice are not generally realised by electrical engineers. Indeed, when I have observed any reference at all to medical electricity in the proceedings of this and of kindred societies, the reference has usually been one of disavowal and dislike. I therefore feel that in making the present communication to you, I am undertaking the task of trying to show that electrical applications have a large and legitimate field of usefulness in medical practice; that it is quite possible to practise medical electricity without thereby becoming an outcast, and that the advertisements of electropathic or medical appliances do not represent the position of medical electricity any more than, shall we say, Keeley represented all that was best and truest in electrical engineering.

If what I have to say to you may seem to be about trifling matters, I hope you will bear in mind that our unit is the milliampere, while yours is the kilowatt, and that the currents which we handle and use would make but a small figure if their energy were expressed in terms of horse-power. Nevertheless, in the small delicate matters which have to do with the management of various kinds of small electrical apparatus, the medical man requires a thorough proficiency, because it is absolutely necessary that he shall be able to make his apparatus work. On that account we may appear, in certain matters, to take elaborate precautions which might seem to you to be hardly necessary. With our coils and batteries we require unfailing methods for increasing or decreasing the current sent through the patient, without stops or jerks. We have to deal with the electric light mains, either direct or alternating, or both. And we have evolved for ourselves a long array of contrivances for utilising the public supplies of electricity for medical purposes. Small transformers, portable accumulators, resistances to provide slopes of potential, which can be tapped as desired for varying voltages, contrivances for using the mains for all sorts of medical purposes are all enlisted in medical work. The statical machine is also coming again into favour, and to use a statical machine one must know enough about its management to be quite sure that after a patient's arrival there shall be no awkward failure of the machine to excite. Otherwise we are likely to be condemned as not understanding our apparatus, and the patient may be lost. All these little matters can only be learned gradually, and through a course of failures and disappointments. And when they have been learned thoroughly, they constitute a very fair claim to the title of electrician.

The use of electricity in the production of hot air baths with incandescent lamps or electrically-heated coils of wire as the source of heat is a development of some promise; while, in the immediate future, we can see the approach of new methods of treatment by the light of the arc lamp. Each of these will demand a fresh extension of the field of electrical operations which the medical man will have to learn.

And now I feel sure that some of you are ready to ask what can be done with all these numerous forms of apparatus. You might be inclined to ask me, as a patient of mine asked me the other day, whether I had ever done anybody any good by electricity.

We will take the simplest things first. No doubt it is familiar to all of you that an electric shock produces a muscular contraction, but possibly you may not all be aware of the extent to which the study of the muscular contractions has been developed. The muscles and their nerves are tested by the application of the induction coil current, and by the direct current of a battery of cells; the effects at opening and at closing of the circuit, the comparison of the action of the positive pole with that of the negative, and the measurement of the current needed to produce visible contractions are all examined, and in this way a system of electrical testing has been devised which affords the most valuable indications in the diagnosis of diseases of the nervous system. An important part of the work in the electrical department of a hospital is the testing and reporting upon cases of injury or disease of the various portions of the nervous system and of the muscles, and the accuracy of the answers given by electrical testing is something to delight one. For exactness and simplicity in its responses, one might compare electrical testing to the processes of measuring with a yard measure or weighing in a pair of scales; and numerous cases which are quite obscure until tested electrically become as clear as daylight as soon as the test has been made.

The behaviour of a muscle under electrical stimulation is peculiar, and I think it may be useful to describe it. A simple shock, such as a single discharge of an induction coil or of a condenser, or a spark from the prime conductor of a static machine, causes a single muscular twitch, which within certain limits is proportionate to the energy of the discharge; the contraction lasts about one-tenth of a second. A rapid succession of shocks causes a succession of contractions, which become fused, so that the muscle enters into a permanent state of contraction, which lasts as long as the stimuli are applied. Stimulation applied to a nerve causes contraction in its corresponding muscles, and when the stimuli are applied to the muscle itself, it is through the agency of its nerves that the stimulation acts.

With a continuous current the behaviour is different. Here there is a twitch at the moment of closing the circuit through the nerve or the muscle. The muscle then remains quiescent and almost completely relaxed while the current still flows, and another twitch is produced when the circuit is broken. This is the sequence of events with the currents of about 5 milliamperes, which are used for testing. With currents four or five times as strong the muscle enters into permanent contraction with continuous currents. These contractions at make and break may seem to recall the phenomena of electro-magnetic induction, but the analogy is more apparent than real.

In certain kinds of paralysis these reactions change, and all irritability of the muscle to coil currents disappears. Stimulation of the nerves gives no response either to coil or cells, but the contractility of the muscle remains for currents from the cells applied directly, and may be more easily excited than in health, while the contraction itself changes in character from a rapid twitch, lasting one-tenth of a second, to a slow, sluggish movement, lasting three times as long.

Stated briefly, the above are the observed facts of what is known as the reaction of degeneration. Its value depends upon the fact that it occurs only when the cause of the paralysis occupies certain definite portions of the nervous system. By its presence or absence we can therefore determine with great nicety the seat of the disease or injury. A point which is not yet explained is why the coil discharge should become ineffective on muscle which retains the power of responding to the battery current. What are the electrical differences between the two modes of stimulation?

Next as to electrical treatment. Progress in medical treatment usually moves along two lines. One of these is based upon experimental physiology, that is to say, upon a study of the various processes in healthy tissues, and depends on the application of the facts observed to various morbid states. The other line of advance is by direct experiment in a more or less haphazard manner upon the sick. In medical electricity, as in medicine generally, both these lines have been followed. If we consider the first, we can apply the observed fact that electricity is a stimulus to certain living tissues, by asking how stimulation may be made use of in disease. The fact that electricity is a stimulus is easy to perceive in the case of nerve and muscle, and in the case of the sensory nerves of the body, and it is not difficult to prove that it acts in this way upon all living tissues, and the employment of electricity in disease is very largely an application of this process of stimulation.

Beard and Rockwell in the United States, and Débédat in France have shown experimentally that in young animals the rate of growth can be accelerated by suitable electrification. The former electrified daily two young puppies, and found that they grew faster than those of the same litter which were not electrified. Débédat in the same way proved an increase of weight in certain muscles of rabbits as compared with other non-electrified muscles in the same animals; the latter thus showed a local effect from localised electrification, the former a general effect from general applications, and this division into general and local treatment is a useful one. Thus, for general diseases, one gives a general treatment, and for local diseases a local application. D'Arsonval, by calorimeter observations and chemical analysis of the expired air, has established the fact that electrification increases the activity of the tissue exchanges of the body. Capriati recently has shown by careful dynamometric researches that the application of electricity to the central nervous system in the form of a continuous current along the spine does undoubtedly increase the muscular power, and that applications to the muscles of a limb have the same effect. In the United States it is becoming fairly common for athletes to undergo electrical treatment when preparing for a contest. General electrification applied to cases of simple failure of nutrition, such as debility after illness, or debility of any kind, produces a rapid improvement in the condition of the patient. In rickets, which is a comparatively simple form of defective nutrition, electrical applications have been shown by many observers to have a very high value. The more complex forms of defective nutrition such as rheumatism, gout, and diabetes are not yet completely controlled by electricity, but indications are not wanting that in time good results may be expected. Already electricity is doing much for these conditions.

In the field of paralytic conditions there are certain strict limitations to the utility of electrical treatment, and it is here that electricity has lost credit quite undeservedly. People have expected electricity to work miracles, and because it could not do so have condemned it as useless altogether. When paralysis is due to some mechanical obstruction or destructive process in the nerve centres of the brain or the spinal cord, or when it is due to certain progressive degenerations in the quality of those parts, then electricity is powerless to help. So, too, when paralysis is due to a breach of continuity in a nerve trunk, electricity can do nothing until the surgeon has intervened and re-united the severed ends. In the latter case electricity comes in quite properly afterwards to promote the recovery of functions which had fallen into abeyance; in the former the surgeon cannot help, neither can electricity. Therefore it is very important to insist that in paralysis there are cases suitable for electricity and cases which are unsuitable. Happily the number of those which are greatly benefited by electricity is a considerable one.

Another field in which electricity is useful is in the relief of pain. Oftentimes it acts by influencing the circulation in the painful part and relieving congestion and pressure in the blood vessels. This I believe to be its mode of action in sciatica, lumbago and rheumatism, and in some neuralgias. At other times it seems to relieve a neuralgic pain by some direct influence upon the nerve trunk in which the pain is felt. Effects upon the circulation are probably the important factor also in the relief of sprains, and in removing the chronic stiffness which may be felt in or around joints as the result of injury or disease. In this there is scope for considerable development. The good results which can be obtained are undoubted, although it is not generally known that this is the case.

Electricity can also be used to promote the passage of drugs into or through the skin, and this has a few minor applications in medical practice, among others for the introduction of cocaine to produce a local insensibility in minor surgery.

Electrolysis, again, is often useful in many small matters of surgery. It is used almost exclusively as a means of destroying tissue. Small tumours of various kinds can be very conveniently treated by electrolysis. The process is carried out by the introduction of metallic needles into the tumour, the products of electrolysis being thus liberated in contact with the tissue to be destroyed. The chief convenience is the ease with which one can regulate the strength of current, and the amount of caustic chemical liberated, in exact proportion to the work required to be done. So fine and so delicate an application can be made that the root of a single hair can be destroyed without leaving any visible scar, and the removal of superfluous hair in this way is a matter for which electrolysis is continually applied. Electrolysis with copper or zinc anodes with the object of procuring the liberation of salts of these metals in the diseased tissues has been recommended abroad, but does not seem to have received much attention in this country.

One of the most encouraging points at the present time in medical electricity is the improved quality of the scientific work which is being done in it. Last year, the French Government having declared the subject to be of public utility, a section of medical electricity was inaugurated at the Boulogne Congress of the French Association for the Advancement of Science. I attended the meetings of the section during the greater part of the Congress, and was struck by the number and high scientific quality of the communications which were made in it. It was one of the best attended sections of the whole Association. France, indeed, takes a long lead in the subject of medical electricity. They have at the present time three periodicals devoted entirely to the subject, and abundance of material seems continually forthcoming to fill the pages. One of them, the *Archives d'Electricité Médicale*, is quite indispensable to students of medical electricity, for in addition to its original matter, it provides its readers with abstracts and a bibliographical index, which keep one in touch with all that is being done in medical electricity all over the world.

The progress in the small matters of detail, particularly with regard to apparatus, which has taken place during the last ten years, is considerable. I say ten years because that represents the time during which my attention has been specially directed towards medical electricity.

It will be interesting to consider and compare the types of apparatus in common use to-day with those used formerly.

*Electrodes.*—The current is applied to the body of the patient by means of electrodes. These may be of the most varied forms, particularly with electrodes for internal applications. The cylindrical brass handles fitted with sponges and held, one in each hand, are obsolete, or deserve to be, and for most external applications their place is now taken by a plate of flexible metal enclosed in wash-leather, and a disc of metal, also covered with wash-leather, and screwed into a wooden handle. The former is called the indifferent electrode, and serves chiefly to complete the circuit through the patient's body; the other or active electrode is the one which is manipulated and applied over the affected region. For testing the active electrode is fitted with a closing key. Examples of electrodes and other forms of medical electrical appliances are as shown upon the table. Bare metal must never be allowed to touch the skin unless electrolytic, or painful effects are desired. Sores are easily produced in a few minutes by a few milliamperes of current, if at any point the metal of the conductor touches the skin directly. For this reason some water-holding material, such as wash-leather, is always used to cover the metallic surfaces of medical electrodes.

*The Battery.*—The chief requirements in a medical cell are that it shall need no attention, and shall not spoil on open circuit. The past few years have seen the almost complete disappearance from medical work of open acid cells such as the Smee cell, the Bunsen, and the bichromate cell. Formerly, when electrical treatment had to be carried out by means of ponderous oak boxes filled with cells of one or other of these kinds, the trouble and the dirt associated with them were enough to discourage all except enthusiasts. At the present day the Leclanché cell is the only type of battery which a medical man need consider, and even these are rapidly being abandoned, except for fixed installations, in favour of the modern, cheap, and convenient dry cell. With these small dry cells for currents of small magnitude and with a few accumulator cells for those medical purposes which require a current of an ampere or more, as, for example, for the heating of galvano-cauteries and the illumination of small exploring lamps, the medical man is sufficiently equipped, and is no longer compelled to handle and prepare caustic solutions. Large bichromate batteries still survive in remote districts for the occasional production of large currents, but they are every year becoming less numerous, as secondary cells and the means of charging them from dynamos become more general over the country. All this simplification tends very greatly towards the increased popularity of medical applications of electricity, because, perhaps, one chief cause of its neglect has been, hitherto, the trouble of the management of the apparatus.

The batteries needed for medical work divide themselves into two distinct classes, batteries for applying currents to patients for testing and treatment, and batteries for galvano-cautery and lamp apparatus. The former is essentially a physician's battery, the latter is more for the surgeon. Most of the surgeon's requirements are met by a portable accumulator of four cells, for the little surgical lamps are for the most part 8-volt lamps, taking about an ampere; though usually they are overrun most cruelly. For galvano-cautery the currents average from 5 to 10 amperes, but the cautery circuit has a low resistance and a pressure of eight volts is much more than is required. Sometimes the four-cell accumulator is arranged so that a switch will recombine it as two sets of two in parallel for cautery work, or else it is left as a four-cell battery in series, the volts being expended in a resistance. For medical work a battery is fitted with 25 to 40 small dry cells connected in series and having wires led off from them to a circle of studs from which a moving pointer takes up into circuit as many cells as are required. It is usually fitted with a milliampere meter permanently in circuit and a commutator for reversing the poles, also with an induction coil driven by a separate dry cell. The average working resistance of the human body and skin is about 2,000 ohms when properly moistened with hot water. Salt or soda may be added to the water to reduce the skin resistance, but plain water is best, as it corrodes the electrodes less.

Next in importance to the battery of primary cells comes the induction coil. Indeed, if generality of use be considered, the induction coil should come first, as it is the form of electrical application which has the widest employment. The medical induction coil has developed in certain special directions, the chief requirement with such an apparatus being a means of careful regulation of its strength.

Of the various ways of obtaining this regulation, the one best suited to our purpose is the plan of using a sliding secondary coil, which can be brought close to the primary or can be removed further from it, as desired. Much has been done of late years to improve the induction coil, and more has been written about the various effects to be got from coils of different sorts and construction. Attention has been given to the improvement of the vibrating spring or contact breaker, and the best American coils are now fitted with two vibrators, one of slow speed and one of high speed. In the United States, where the construction of electro-medical apparatus has been much elaborated, it is quite customary to supply coils with several interchangeable secondaries. The same is done to a less degree by makers elsewhere. The various effects which have been ascribed to different windings of secondary are best considered as being due to the very great differences in their self-induction, according as they are made with windings of great length and many turns, or of short length and few turns. The slower rise and fall of wave which is found with the high self-induction of the long coil of many windings has the effect of making the shock less sudden and less painful in its effects. So too in very long fine secondaries a large part of the volts are dropped inside the coil, and the E.M.F. at the terminals, though high on open circuit, may fall almost to nothing when closed through a comparatively low resistance. On this account very long coils with very high speed contact-breakers have been much written about as affording painless currents for internal applications, but in my opinion the painlessness is due to the fact that very little current comes out of them. For practical purposes, I have usually found it sufficient to use one secondary coil, which is tapped at one-third of its length, and so can give long coil and short coil effects from the one instrument. Medical induction coils are not fitted with condensers.

*(To be continued.)*

## COAL ANALYSIS.

### I.

The American Chemical Society has published a very valuable report on coal analysis. Coal is very much the same the world over, that is to say, it is sufficiently the same in material to render a chemist's report on the methods of analysis equally valuable in all coal-producing countries; and in this, and subsequent articles, we propose to present such a digest of the report as may be sufficient without reproducing the report *in extenso*.

In a small calorimeter it would be easy to obtain widely discrepant results with samples selected from the same heap of coal. The true sampling of a lot of coal is thus a matter of particular moment. To sample a truck-load of coal the method recommended is to take six scoopsfull of coal along each side of a car (long American cars) and six along the middle, beginning in one corner. The scoop is to be driven vertically down as far as it will reach. These 36 full scoops are to be placed on a close-tight floor, and all pieces larger than an orange are to be broken, and the whole heap mixed by shovelling it back and forth over itself. It is then divided into quarters and the opposite corners rejected, then broken finer if necessary and again quartered down until finally the half remaining will go into a quart jar and contains no pieces larger than a fourth of an inch cube. It may then be sealed up. All this is rapidly to be effected so that the moisture percentage may not be affected; or shovelsfull of coal may be taken at regular intervals during the unloading of a car, and generally such methods must be followed as are calculated to give average results. Unless the coal is less than 2 per cent. moist, the sending of samples in wooden boxes is to be avoided.

For boiler testing shovelsful of coal should be taken at regular intervals and put in a *tight covered* barrel or other air tight box, protected from the heat of the furnaces.

In sampling a mine the map of the mine is to be examined and points selected for sampling that will fairly represent the body of the coal. These points should be placed close to the advancing crescent-shaped front of the workings. Before the samples are taken a fresh cut of the face is made from top to bottom, to a depth sufficient to ensure absence of possible changes or of sulphur from blasting charges. The floor is then swept, a canvas spread, and the seam cut down vertically 3 inches wide by 1 inch deep, with a chisel, leaving, however, any bands of shale if the practice of the mine separates these from the coal furnished to customers.

The coal thus cut is broken at once into ½-inch cubes on the canvas, and mixed and quartered down until the last division will fill a quart jar, which can then be sealed up. If the seam varies in thickness, the amount of each sample must be proportionate to the thickness. This can quickly be done by using a small measure and filling it once for each foot of thickness of seam.

In addition to the general samples, any specially different coal should be separately sampled from the seam.

For analysis the quartering down system is carried down to 100 grammes. This is then run through a coffee mill set to grind as finely as possible, and at once closed up in a tight glass tube for determination of moisture. Another 12 or 15 grammes is then ground up for the purpose of determinations other than moisture. It need not be ground up so fine. Too much caution cannot be exercised in sampling, and the committee give a strong recommendation to be careful in the treatment of the samples in order to secure reliable results, to emphasise which they state two cases of lignites, the moisture in which was made to appear the reverse way, and a grave injustice thereby done one of the parties interested. Some of the American Western coals will, it is stated, lose several hundred pounds weight daily while the car is standing on the track, and the same coal may lose several per cent. of moisture by standing some days or weeks in a loosely stoppered bottle.

The determination of moisture is made by drying one gramme of the coal in an open porcelain or platinum crucible at 104—7° C. for one hour. This is best done in a double walled bath containing pure toluene. For coals high in moisture, determinations must be made of both coarsely and finely ground samples. Usually there will be more moisture in the coarser sample, and a correction must be applied to the finer determination. The following is the procedure for finding the true moisture percentage:—

| | Coarsely ground sample. | Finely ground sample. |
|---|---|---|
| Moisture ... ... ... | 12·07 ... ... | 10·39 |
| Volatile combustible matter | ... ... ... | 34·25 |

Then the correction for moisture will be $\frac{12{\cdot}07 - 10{\cdot}39}{100 - 10{\cdot}39} = 0{\cdot}0187$,

and the true percentage of volatile combustible matter will be

$$34{\cdot}25 - (34{\cdot}25 \times 0{\cdot}0187) = 33{\cdot}61.$$

It is possible, of course, that both moisture and volatile matter may be correctly determined from the coarse sample, but data are wanted to prove this, and meantime the volatile matter seems best found from a finely ground sample.

Toluene is recommended for the bath because of its convenience, but any other bath will answer equally well. Beyond one hour's exposure the sample begins to gain weight, probably from oxidation, and a higher temperature than 107° C. appears undesirable.

Dr. Hillebrand has dried coals in vacuo over sulphuric acid, and this to us seems to be a sound system, but the committee do not appear to endorse it. As this is a matter of importance, we reproduce the figures obtained by Mr. N. M. Austin. His results are mostly averages of 2 to 6 determinations.

| No. | Toluene, 1st hour, 107° C. | Toluene, 2nd hour, 107° C. | Xylene, 1st hour, 138° C. | Xylene, 2nd hour, 138° C. | In vacuo over sulphuric acid, 7 hours. | In vacuo over sulphuric acid, 24 hours. | In vacuo over sulphuric acid, 64 hours. |
|---|---|---|---|---|---|---|---|
| 1 | 0·97 | 0·92 | 1·03 | 0·98 | 1·17 | ... | 1·18 |
| 2 | 4·55 | 4·61 | 4·60 | 4·56 | 4·69 | ... | 5·05 |
| 3 | 1·39 | 1·27 | 1·27 | 1·15 | 1·46 | 1·45 | 1·56 |
| 4 | 1·31 | 1·29 | 1·27 | 1·20 | 1·35 | 1·36 | 1·39 |
| 5 | 1·00 | 0·97 | 0·97 | 0·96 | 1·10 | 1·14 | ... |
| 6 | 1·44 | 1·31 | 1·22 | 1·15 | 1·46 | 1·49 | 1·56 |
| 7 | 14·53 | 14·23 | 14·85 | 14·28 | 14·91 | 15·47 | 15·25 |
| 8 | 8·43 | 8·21 | 8·31 | 8·22 | 8·91 | 8·90 | 8·95 |
| 9 | 1·34 | 1·32 | 1·23 | ... | ... | ... | ... |
| 10 | 10·50 | ... | ... | ... | 11·04 | 11·55 | ... |

The committee believe in the drying in vacuo when great accuracy is required, and in cases where the determination is to be combined with an ultimate analysis, but unless sampling is better controlled than at present, the difference of the two methods—only 0·37 per cent.—is hardly enough to justify the adoption of the new method. The small difference due to higher temperature does not warrant the increase. The point to observe is that the temperature of the bath should be above the boiling temperature of water, and this is well secured by toluene, which boils at a temperature somewhat above that of water.

*(To be continued.)*

## SOME CONSIDERATIONS AFFECTING THE TRAINING OF YOUNG ENGINEERS.

By W. C. BORROWMAN, Wh. Sch.

(Abstract of paper read before the North-East Coast Institution of Engineers and Shipbuilders, at West Hartlepool, February 24th, 1900.)

As early as the fourteenth century there were instituted guilds and corporations for the purpose of protecting skilled labour, and for maintaining certain exclusive privileges, the violation of which, it was thought, would be detrimental to the public at large. These guilds were not merely confined to the trades of the time, but the learned professions as well were formed into self-governing bodies for the purpose of exclusively protecting their respective arts, and as in the course of time these professions and trades multiplied, the teachers and taught combined to form corporations or universities, the teachers being the masters, the learners the apprentices.

There is no doubt that this system of apprenticeship, as instituted by these old guilds, was one of the chief reasons why we maintained so long the first place in manufacturing industries. The pity is, that along with the special training of the apprentice in handicraft there was not incorporated with it some system of technical education. The importance of the development of this technical side of education has now become fully recognised, and by none more so than by our leading political economists, who see in its progress the essential basis of the future industrial, as well as social, advancement of the nation. They see that if besides his cunning hands a man has

a well-stored mind and is technically educated, his value rises, and he becomes of a stock of educated artisans upon whom depends, in great measure, the country's prosperity.

In engineering all this has been especially true, as it is not too much to say that the commercial prosperity of our country has been largely, if not entirely, created by its engineers; and if the prominence to which we have already risen as a nation in industrial arts is to be maintained in the future, we must not fail to produce that material out of which good engineers are made.

So much has recently been written of industrial progress and competition in other countries and of how other nations are gradually overtaking, if not actually passing, us in the industrial race, that our attention might not unprofitably be directed for a short time to-night to some of the educational requirements of our apprentices and young tradesmen, and to some of the means of meeting them.

It is now fully admitted that the training of an apprentice engineer should be twofold, and that careful instruction in principles as well as experience in practice should be included in it. But where diversity of opinion does still exist is in what is the best method of dividing the time between the classes of the technical college and the departments of the workshops. The question whether theory or practice should come first, or whether they should be taken simultaneously, or even as complementary to general education, is a problem exceedingly difficult of solution, if soluble at all. One thing is certain, the old methods by means of which young engineers were trained in their profession and so equipped for a practical life are altogether unsuitable now.

What are the conditions that obtain at present in the process of an average apprenticeship? After finishing his course of elementary education at school, a lad suddenly finds himself turned loose into one of the departments of a workshop, and is there left to learn his trade as he best can. In the old days an apprentice used to be taught a definite craft, and his trained hand was of the highest value in work demanding the use of hammer, chisel, and file; *then* he was trained in all the details of his trade, and, after a definite pupilage and with the object of mastering the outlying branches of it and widening his practical knowledge and experience, he became a journeyman before finally developing into a master. *Now* he learns only a portion of his trade, because he is trained amongst men who are capable of doing little more than one thing, who are dependent upon a series of other men, or sets of other men, to either finish what they have begun or begin what they will subsequently finish. Now the introduction of exact machinery has almost banished handicraft altogether, and cheap and rapid production by minute sub-division of labour renders it impossible for a workman, unless he be of exceptional character, to so exercise his hands and mind as to develop deeper insight, broader view and capacity and brighter intelligence, and so, if he be only skilful with his hands, he becomes no better than an unskilled labourer the moment his work can be performed by means of a new machine.

On the other hand, if while young he is drafted into some technical school where the aim is to give instruction of a specialised character with the object of commencing him in the elements of his professional training, there is the danger of stinting and narrowing his mental growth, of antedating the cramping effect of a specialised calling, and, just as in the case of the specialised workman who can do only one thing well, we have a lad whose mind is trained only in one direction, who is incapable of forming any but the simplest and most commonplace ideas, and who only fixes his attention on those features of his profession in which he finds himself most proficient, and leaves out of account altogether those other features which are none the less important and essential to his full development.

Before determining, then, which course of training should be chosen as being the best, a youth should know, or be led to know, the powers of his own mind, and the chances of a successful career he may have to his hand in the future. If he be of the material which goes to make a good engineer, it perhaps matters little which course he chooses first; his ability and bent of mind will soon become apparent, and he will probably be able to mould his career into lines at once most congenial to his taste and in keeping with his temperament. And so, to study our subject fully and before either technical college or practical workshop is considered, we are forced a step further back still, and have to inquire—what of the ways at school? There the real preparation for the after training should be made, there a sound foundation for the after professional work should be laid and *method* should be all and in all; the method of learning how to learn. To the engineer, as to every other business man who has frequently to decide rapidly when neither his text-books nor his notes are at hand for consultation, a well-trained memory is absolutely necessary. To remember well is sometimes of as much importance as to understand well. To train the memory demands its application, and in the process the mind is stored, and if with retentiveness of memory there be associated a correct method of reasoning, a correct habit of arranging in proper and natural sequence all the facts of a problem, it is no longer found to be an effort to remember them, and its training therefore should have every prominence in a general school course.

There has always been great diversity of opinion regarding the best methods of thus strengthening the mental powers. Until recently it was claimed that nothing whetted the intellect or strengthened the mind like a study of the classics. The very fact that the system of education was not essentially different from what it was several centuries before ought to have been sufficient evidence that some alteration was needed. Life, and especially educational life, is far too short to permit of any portion of it being spent in acquiring a knowledge that only *may be* useful, for, speaking generally, it may be taken as a fact, although one regrets to have to say it, that the primary object of all education, whether it be what is termed liberal or merely professional, now as in antiquity, because even in Plato's day there were the philosophers and dramatists and artists teaching liberal education, while the Sophists supplied the professional side, is not altogether to develop the mental and moral qualities of the pupil for their own sakes, but to enable him to make a respectable living, to become a useful citizen, to convert, in other words, his brains into money! And when this is said, it is not intended to contradict what has been said already, that the primary object of the school period is to acquire an orderly method of learning, and that the nature and amount of the knowledge acquired are only secondary; but are not secondary results sometimes very important and not to be disregarded altogether? Hence it is held that there is a direct advantage, both from an educational and professional point of view, with newer studies unfolding themselves before us, to so arrange the school course that it shall be potent for cultivating all the faculties of the mind and bringing them into full and healthy activity, and in which classics have only a moderate part. Living languages are surely quite as capable of polishing our brains as dead ones, and to the student of science, history, music, drawing, there would be opened up such a world of delight as the youth who has spent all his time at classics cannot even imagine. The whole purpose of the school, then, should be to so prepare boys as to render them capable of succeeding in any calling they like to choose afterwards, through the advantage derived from a healthy, active intelligence, a habit of logical reasoning, and a stock of useful knowledge.

As success in every walk of life depends to a great extent on early training, every healthy boy in the country should be made to undergo some such elementary course as has been indicated. When this has been accomplished, the specialising of his studies, his secondary education, his technical education, if you will, may be commenced. By this time a boy will have had opportunities of developing any capacity he may possess, and the process of selection may commence. Up to this period education should be general and universal.

It is at this stage that the difficulty already referred to, the choosing between a course of theory and one of practice, crops up. If the lad is to be something more than a workman, he must be guided in the proper selection of a course of study. Hitherto he has been chiefly absorbed in book work, in verbal studies, in which his memory and reasoning faculties alone have been exercised. His eye and his hand still require disciplining before he becomes a fit scholar for skilled labour and a practical life. Now hitherto the teaching of science in its relation to trades has been, in this country, firmly restricted, and the teaching of the practice of a trade in any technical school where Government support was given has always been forbidden. While something can perhaps be said in support of this in the case of colleges and universities, it becomes a question whether it should be so strongly objected to in institutions for secondary education. It is, of course, absolutely impossible to give any considerable useful, practical information of any art in such institutions, but a workshop in such a school would be a most useful adjunct for providing certain deserving boys with the means of acquiring a little skill in a healthful and pleasant way. And remembering the importance of permitting a boy to form some opinion as to what is, and what is not, of practical value to him, and thus allow him to pay more attention to the former, to guide him in determining which results will be of real use, and which will form only exercises in applied science, and with the further benefit of saving much precious time, it is suggested that a short course in the laboratory or workshop of a technical college should be taken between the time of leaving the general education school and that of commencing his apprenticeship. There he would be shown and become acquainted with ordinary tools and materials. He would be under the charge of trained and competent tutors, who would teach him their uses, and in a manner utterly impossible in the average commercial workshop.

(*To be continued.*)

## LONDON COUNTY COUNCIL.

### The Islington Loan Dispute.

At last Tuesday week's meeting of the Council the Finance Committee reminded the Council of their report in January on applications from the Islington Vestry for sanction to the borrowing of £13,200 and £56,261 for electric lighting purposes. It was then stated by the Committee that the information and details supplied only justified them in recommending the Council to agree to £10,000 and £38,000 respectively on account, and the Vestry were informed that the question of sanctioning the balances would be considered on the necessary details and information being furnished. A letter had now been received declining to accept the proffered sanctions on account, and stating that the Vestry, from a report by their electrical engineer, were satisfied "that every detail and measurement given in the estimates and specifications which accompanied the applications is substantially correct, and further, that sufficient information has been afforded the Council to justify such applications, which it is now feared, owing to the delay in obtaining the Council's sanctions, will prove to be insufficient."

Commenting upon this attitude, the Finance Committee expressed the opinion that the Council, as the sanctioning authority, was the sole judge as to the sufficiency of information supplied by local authorities applying for sanction to loans, and that the position which the Islington Vestry apparently took up in regard to the matter was quite untenable. Continuing, the Committee said:—

With regard to the loan of £13,200, the Vestry have not satisfied us that the prices making up this sum are fair and reasonable, and we were consequently unable to recommend the sanction of the sum asked for until fuller information as to prices was given. In order, however, to meet, as we thought, the convenience of the Vestry, we recommended the sanction of £10,000 on account, following in this respect what we understand is the practice of the Local Government Board in such cases. We adopted a similar course as regards the loan of £56,261. To enable the Council to judge as to the reasons why we have been unable to recommend the sanctioning of the total sum applied for, we submit the following statement, which in the latter case, shows clearly the points with regard to which we require explanation. Three points on which further information was desired were put to the clerk of the Islington Vestry in a letter from the chief engineer of the Council on October 27th, 1899.

**These points were set out in tabular form, and the replies given by the Vestry clerk were placed in parallel column, whilst a third column contained some observations on these by the Council's engineer, showing that, in the opinion of the Committee, further information was required. It may, however, be well to reproduce the tabular statement in another form, where A, B, and C represent the points raised by the Council's engineer, A 1, B 1, and C 1 the replies of the Vestry clerk, and A 2, B 2, and C 2, the remarks of the Council's engineer. In this form the three points are indicated as follows :—**

A. Hornsey, Newington Green, and Highbury arc lighting schemes—The lengths of cable given in your schedule do not appear to agree with the lengths as shown on the plans. A 1. The actual length of cable must of necessity exceed the length of frontage on account of connections, waste, &c. It is estimated that this excess works out at something like 25 per cent. This has been admitted in former sanctions by the Council. A 2. It is not questioned that the actual length of cable must exceed the length of frontage, but the excess appearing in the particulars given by the Vestry is excessive and is not explained by Mr. Dewey's letter. Thus the length of 19/14 cable in certain streets as measured on the plans amounts to 9 miles. The length for which the Vestry ask a loan is 12½ miles, an excess of about 39 per cent. Again in another description of cable the length measured on the plans is 13 miles ; the length for which a loan is asked is 20½ miles, a difference of 58 per cent. Thus it will be seen that even an addition of 25 per cent. does not account for the difference, and 25 per cent. itself is an excessive addition. In former cases the allowance for Islington has sometimes been 20 per cent., and this is undoubtedly a most liberal allowance.

B. In the Highbury arc lighting scheme an amount of £15 each is included for 68 connections. Probably there is some omission here in the description of the work. B 1. The amount of £15 per connection is considered low rather than excessive. Many of the lamps are at a distance from the mains, and the estimate includes the cost of opening up ground, laying and jointing pipes, and connecting to the bases of the lamp columns. B 2. The average length of connection between the arc lamps and the mains as taken from the plan appears to be under 12 feet, and unless there is something unusual in the work which is not stated, it is impossible to see how the £15 can be spent.

C. The prices for mains and conduits and street work combined appear very high unless there are special circumstances to account for it. C 1. Here, again, the engineer is convinced that, if anything, he has under-estimated in his prices for mains, conduits, and street work combined, and having regard to the upward tendency of prices generally, he is afraid that it will be necessary later on to send in a supplementary estimate. C 2. Mr. Dewey's reply simply states that in the opinion of the Vestry's engineer the prices are low.

The Finance Committee mentioned that the tabular statement had been forwarded to the Vestry with a request that they would supply such further detailed information as would enable the Council's engineer to deal fully with the matter, but the only communication received from the Vestry was that quoted at the beginning of the report. As the Committee could not take any further steps in the matter until the Vestry had furnished the details asked for, they had instructed the clerk of the Council to inform the Vestry to that effect.

Mr. Elliott proposed that the Council should not receive the report of the Committee. In doing so he referred at some length to the actual position of Islington in regard to the loans, and quoted from the report of Mr. Gay to show that the Council was in the wrong. By way of comparison the speaker stated that the Islington application filled 17 pages of type-written matter, and was accompanied by nine plans, whereas in a similar case the application of West Ham to the Local Government Board only occupied nine lines. The Council's engineer had not carefully considered the plans, the facts and the circumstances of the case, and if the report was received and no action was taken upon the matter, the Council would practically stop electric lighting in the largest parish in London.

Mr. Howell Williams having seconded the motion,

Mr. Benson and Colonel Campbell also discussed the question.

Mr. Bruce, chairman of the Finance Committee, stated that one of the replies from Islington implied that the Council was not to make any inquiry, but to accept the statements made. That was, however, contrary to the law. In the country the period for loans was 25 years, but in London 42 years were allowed for repayment by the Treasury authorities, who had stipulated certain conditions which the Council had to require to be fulfilled.

The motion for the non-reception of the report only received four supporters, and the report was then adopted.

### The Westminster Company.

It may be remembered that last August the Council conditionally consented to the change of the standard pressure of the Westminster Electric Supply Corporation from 100 to 200 volts. The Highways Committee now stated that complaints had been made by some of the company's consumers that as they were not prepared to accept the increased pressure on the terms offered by the company, including the alteration of the service wires and the electric light fittings on their premises, the company had raised the price from 4d. to 8d. per unit, and had also required the deposit of a large sum of money. The Committee were assured—

that the consent of the Council to the change of pressure had been very valuable to the company in increasing the value of its undertaking; and this being the case, the conduct of the company in increasing its charges was not justified by the circumstances. Each order granted under the Electric Lighting Acts contains a provision fixing the maximum prices to be charged, and also empowers the Board of Trade at any time after the exp'ration of seven years from August 26th, 1889, on the representation of the Council, the local authority or the undertakers, to make an order varying the price or method of charge, and substituting other prices or methods of charge; and the prices, &c., may again be varied after the expiration of seven years after the last alteration. The maximum price had been fixed in every case but one at 8d. per Board of Trade unit; but the charges made by the various companies differed, and in some districts where there is competition, the charges are as low as 3d. As regards the Westminster Company, the Committee were advised that it could afford to supply at a much cheaper rate current at 200 volts pressure than at 100 volts, especially having regard to the fact that nearly all the consumers in the district had agreed to the change of pressure. Up to the present the question of revision of the maximum price had not been of great importance, the prices actually charged having been below the maximum; but the action taken by the Westminster Company had shown the utility of the provision in the order relative to alteration of the maximum price.

**Having regard to all the circumstances, the Committee had come to the conclusion that the Council should take action for the protection of the public. The Committee accordingly recommended that a representation should be made to the Board of Trade that it was desirable the maximum price allowed to be charged by the company should be reduced from 8d. to 5d. per unit, and that the Board should be asked to consider the matter with a view to such an inquiry being made as the Board might think necessary.**

## AN AUTOMATIC BRAKE.

In many classes of machinery driven by electric motors, the necessity for some form of automatic brake has made itself felt. In the case of cranes and hoists it is required to retain the load when the motor is stopped, and in other cases for the purpose of stopping quickly and with precision.

What is required is a brake which is normally held on by a spring or weight, and which is released by an electro-magnet, the exciting current of which is preferably controlled by a switch attached to the switch which starts and stops the motor. Thus, when the switch turns current on to the motor it simultaneously turns current on to the electro-magnet, so releasing the brake, and when it is turned off it simultaneously interrupts the current to the motor and to the brake, so that the brake renews its grip.

An arrangement which has been used to a certain extent consists of an ordinary band brake with an electro-magnet to lift the lever. This arrangement requires very careful adjustment owing to the short range through which an electro-magnet acts. For the same reason

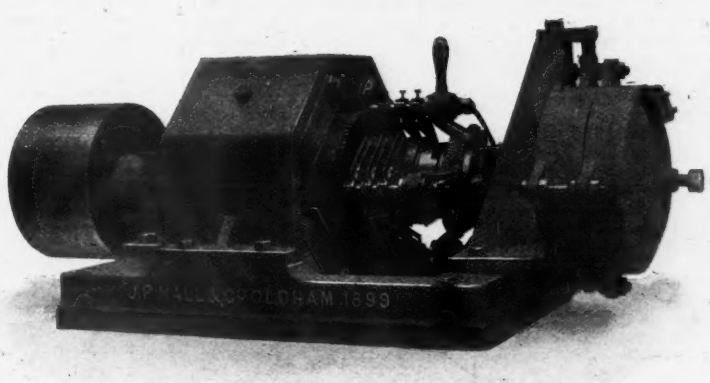



Fig. 1.

any slight wear of the band or pins will cause the brake to slip, so rendering it unreliable.

The brake which we illustrate has been devised to get over this difficulty. It is constructed somewhat on the principle of a Weston friction clutch. A disc slides on a feather key on the motor shaft, and is placed between two plates, one of which is fixed to ithe frame of the machine, and the other swings on a link and is provded with stops to prevent rotation. This movable pressure plate is acted upon by a spring, which presses it, the disc, and the fixed plate tightly together, so that the motor shaft cannot turn. An electro-magnet is provided which, when energised, pulls the pressure plate back and releases the disc. In fig. 1 an illustration is given of one of the brakes fitted to a motor for driving a set of plate-bending rolls, the object being to get quick stops instead of having to wait for the momentum of the motor and gearing to die down. The users have found this a great advantage, as they are now able to get more work out of their rolls than they could before the brake was adopted.

Generally a simple on and off brake is all that is needed, but in some cases, and more especially in cranes, it is desirable that the brake should exert an intermediate pressure between full on and full off. The sectional drawing, fig. 2, shows a brake arranged to give two pressures. There are two pressure plates, $e_1$ and $e_2$, and there are two springs, one pressing on each plate. The magnet

switch in this case requires three points:—"off," "on" through a resistance, and "on" to the magnet direct. The tractive force curve for one of these brakes in given in fig. 3. This brake is intended to exert a total pressure of 4,000 lbs. with an intermediate pressure of

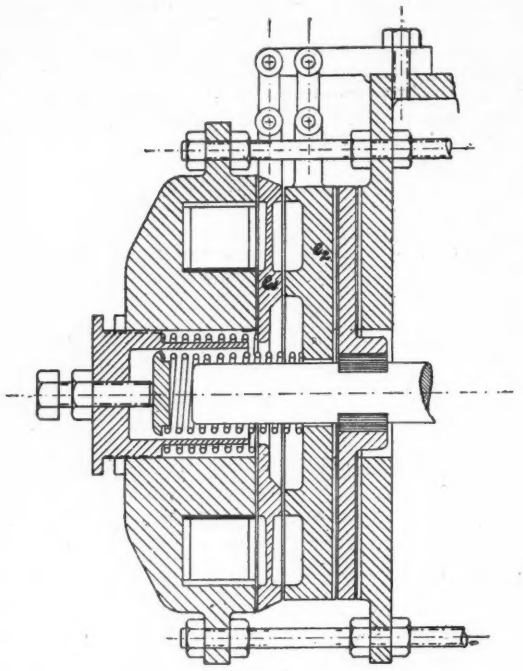


Fig. 2.

1,650 lbs. The plates, $e_1$ and $e_2$, each exert a pressure of 2,000 lbs. Referring to the curve it will be seen that as the ampere-turns round the magnet increase, its attraction increases, till at 2,000 lbs. the plate $e_1$ is pulled over, leaving the plate $e_2$ still pressing on the disc. At this point the attraction (which is now exerted between $e_1$ and $e_2$) falls to 375 lbs. owing to the magnetic short circuit formed by $e_1$. As the ampere-turns are further increased the thin part of $e_1$ becomes saturated, and the magnetic potential across it rises, causing the attraction to increase till at 2,000 lbs. the plate $e_2$ is also pulled

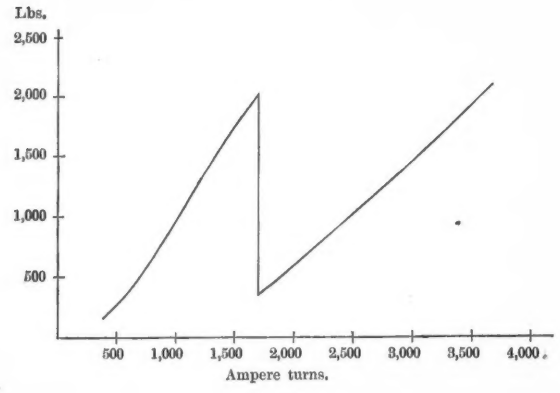



Fig. 3.

over, leaving the disc free. The effect obtained by this arrangement is the same as though two simple brakes were used exerting pressures of 2,000 lbs. and 1,650 lbs. respectively. It is, however, much simpler, the only addition to the simple form being the extra plate and the division of the spring into two parts.

The patentee of the brake is Mr. Claude W. Hill, of Broad Street House, London, E.C.

## THE ELECTRIC WIRING OF BUILDINGS.

Under the above heading Mr. W. A. Chamen recently discussed before a meeting of the Institution of Engineers and Shipbuilders, Glasgow, the general position of the wiring question, with special reference to the various systems in vogue, and their advantages and disadvantages under different conditions. Taken as a whole, the paper forms a very good *résumé* of modern practice in wiring, but, although the author's views seem to have been formed in the school of experience, they do not appear to bring us any nearer to the much-needed standardisation, which certainly cannot become really effective whilst so many different methods of encasing wires are in the field. It is true that the author raises a cry against the want of enterprise on the part of our makers in not providing a safe and satisfactory system of iron tubing, standardised after the manner of our American cousins. But, whilst all the other systems are admissible at the contractor's pleasure, it is impossible to see that the makers have any very great encouragement to get out such a system. The method of installing gas in a building is always held up to us as something which we should endeavour to emulate, viz., in point of cheapness, and in point of simplicity and uniformity; and yet, to take the latter point first, who ever adopts the attitude of our apologists for the various wiring systems and their good points when installing gas in a building? It is all done on one system, iron barrel for mains and iron barrel or compo tube for branches. No gasfitter ever thinks of using wooden tubes in certain positions, because they would work in so nicely with the decorations, nor does he cover his pipes inside or outside with all sorts of compositions to resist heat or cold or chemical action, or use more than one form of joint, the screw joint. Then, to take the question of cheapness, it is as well to give up at once the idea that electrical house wiring, even if installed whilst the house is being built, can ever compete in price with gas piping.

In the first place, the material must always be dearer, as long as we use iron, copper, and insulation against iron only. In the second place, the labour must also always remain greater, when all the little hundred and one things are taken into account which form part of the installation of electric light, apart from the mere running of the tubes and wires. There are the making of electrical joints, the fixing of switches and boards, the wiring of fittings, and many other things which will suggest themselves to the practical man. Therefore, while ever having before us the Eldorado of a standard system and a cheap one, do not let us be led away by adopting anything so cheap, that it will be nasty also.

Mr. Chamen enumerates the objections which are raised against wood casing, but he omits to mention one point in which it compares unfavourably with a round or tubular system, namely, that much more cutting away is required, especially if the work is required to be sunk. Perhaps the most important objection he raises is that two distinct classes of workmen are required, the joiner and the wireman. This is no doubt true, and is perhaps the fault of the firms who employ the men. The wiring "trade" is not worthy of that name, and if firms would remember this, and see that a workman were, in the first place, a joiner or a pipe-fitter, they could very easily teach him the wiring work.

The author turns next to systems of lead-covered wires, and we are glad to see that he quickly dismisses the case of two wires drawn into lead (or compo) tubing, as being worse than that of wood casing, from the point of view of mechanical protection and moisture between the wires. Dealing with single, twin, and concentric lead-covered wires, he points out the fact that if run on the surface, the two first varieties derive greater immunity from nails, &c., than if buried in the plaster, but that if the insulation is hygroscopic, special fittings have, of course, to be used, so that a lead joint may be made. It is rather curious that owing to the way a certain system is largely advertised, people seem quite to forget that india-rubber-covered wires may also be encased in lead, singly or twin, and without the use of special fittings with cast solder bases. As regards the last-named variety, the author assumes, we believe rather rashly, that it has not yet been proposed to use concentric wires with both conductors insulated, and he naturally refuses to discuss the large question of earthing the outer conductor. It is, perhaps, a pity that as so many electrical engineers are now nibbling at this question, someone should not boldly raise the standard of "earthed outer" before the Institution of Electrical Engineers, so that the matter may be properly and fully discussed.

We do not quite understand Mr. Chamen's statement that on a public supply "one conductor at any rate is connected

to earth." He, however, goes on to state that the lead sheathing should always be connected to earth through a water pipe, so that in the event of the sheathing becoming live at a point near a compo gas pipe, the latter should not be the means of neutralising the potential. He also rightly deprecates the use of joint boxes which do not rely on the skill of the workman to produce a good joint, and which are used without the lead sheathing being "wiped" round.

Dealing next with iron tubing, the author discusses gas barrel, skelps (by which, we presume, he means some of the systems so much advertised, which do not have closed joints), and insulating tubing. He appears rather to favour the last, owing to the presumed absence of condensation or contact of the wire with the metal tube, but whilst, very properly, pointing out that a satisfactory job may be made of all three systems, he shows that in the case of gas barrel, which has much to commend it, a great deal of trouble can be caused by careless work, points which have been dealt with at considerable length in these columns. He is rather down on the skelps, but we cannot say that we have noticed any sharp edges on the tubes which have been in the market for some time, nor should they hang on the wires if properly driven home into their sockets. The moral of all these conduit systems is good work and careful supervision, and none of them can be a success without this attention, however much the makers push their goods. Whilst discussing the necessity of making the electrical contact perfect throughout an iron tube system, for the same reason as given under lead-covered wires, the author appears to assume that no proper systems of screwed barrel, with fuse boxes, joint boxes, &c., drilled, tapped, and supplied with lock nuts, have ever been made. In this he is incorrect, as several firms have got out such systems for their own use, and also, we believe, for the general market. He does not see the necessity of going to the extra expense of using tubes lined with insulating material, if wires with good insulation and smooth tubes are employed, an argument in which we fancy he does not stand alone. However, we can hardly agree with his statement that if well insulated wires are drawn into smooth tubes they should have a long life because they are not subjected to alternate conditions of damp and dryness. Surely that is just what they are subjected to in unlined tubes, but possibly the conditions are not so severe as to cause breakdown after a year or two.

After a final tilt at wood-casing, Mr. Chamen goes to the root of the matter by regretting that we cannot rely on our workmen, or those superintending them, to do their work properly. These evils are the cause of the continual agitation for standard systems; every system has more or less the elements of a perfect system if it only has careful work applied to it, but the trade unions have destroyed most of the good workmen who studied their employer and took an interest in their work. The modern working man's motto is *minima labor, maximæ pecuniæ*, and the only way to get good workmen is to train them up and keep them. The author rightly points out that it is usually the labour spent upon the actual job which costs the greater part of the money, and this wiring firms know to their cost. It is only by keeping good men and getting used to their ways that it is at all possible to estimate the cost of labour properly.

The author hints at what he would consider an ideal system, namely, a concentric cable in an iron tube, but he appreciates difficulties in jointing, although he says nothing of bending. If architects would use a little more foresight in designing houses by leaving vertical and horizontal clear runs for electric light wires, possibly Mr. Chamen's ideal might be realised, as the number of joints would be reduced to a minimum and the lengths of tubes could be largely increased.

The author next breaks off to a small historical and descriptive dissertation on tree and distribution board systems of wiring considered in connection with fuses and bunching, but he mainly deals with truisms and statements with which every wiring expert should be acquainted. He, however, severely deprecates the bunching of sub-mains, and he makes a suggestion which practically involves the abolition of the main distribution board.

He wishes to compromise between the tree and distribution board systems by running a pair of mains from bottom to top of a building, and tapping off at the various floors for the different sub-boards. If we are not mistaken, this is very often done, unless a very special system of control from one point is required. We see no particular reason, however, why these rising mains should be of the same section from bottom to top, as he suggests, although in actual practice it might be cheaper to effect this than to go to the expense of putting in double-pole fuses at every reduction of section.

Altogether the paper is a valuable addition to the literature of wiring, and should be read by all those interested in the profession. We fear that too many people are apt to rely entirely on their own experience, and if they would read more about that of others the general community would benefit equally with themselves.

## THE CAPE TRAMWAYS AND THE SUBMARINE CABLE.

A PAPER communicated by Prof. Andrew Jamieson to the Institution of Engineers and Shipbuilders, and reprinted in the ELECTRICAL REVIEW, deals with a question that may affect submarine cable companies in many places in the future. For some years past since the establishment of electrical tramways in Cape Town the working of the submarine cables has been seriously interfered with, so much so that the signals have at times been quite unreadable. The matter was submitted to Mr. A. P. Trotter when he was electrical adviser to the Cape Government, and the remedy that he proposed appeared, it was understood, to meet the difficulty, but since that time the trouble has recurred in an exaggerated form owing to the extensions of the tramways. Prof. Andrew Jamieson and Mr. F. Jacob went last year to Cape Town to advise the Cape Electric Tramways Company on the question, and the paper referred to is an account of the problem presented to them, and of their solution.

The end of the submarine cable from Mosammedes, nearly 1,400 N.M. in length, is connected to the instruments in the cable office at Cape Town, close to the line of the electric tramways, and the connection to earth of the earth side of the instruments was originally made in the office. The working of the electric tramways, and especially the sudden variations of current on starting and stopping the cars, produced electrical currents in the cable which seriously interfered with the working, and the problem attacked at one time by Mr. A. P. Trotter, and more recently by Prof. Jamieson, is to find a way of getting rid of these disturbances.

Rapid variations in the current in a primary system of conductors produce currents in a neighbouring secondary system—in this case the insulated conductor of a submarine cable—in two ways. One depends on the movement of charges induced by electrostatic induction, and is due to the changes in the potentials of the neighbouring points of the primary system. In ordinary transformer work this is negligible, because the mutual electrostatic action between the primary and secondary systems is very small compared with the electro-magnetic action. In the case, however, of a cable terminating in a condenser of 50 or 100 microfarads, and having little mutual inductance with any other conductor, the electrostatic effect might be relatively considerable. The other mode in which currents might be induced in the cable is by electro-magnetic induction, and the effect of this, in the absence of any effective iron circuits, depends largely upon the distance between the cable and the inducing currents, being very small if the distance is large. The trolley wire and the rails of the tramway system form a closed circuit for the electrical current between the power house and the tramcar, and are generally close together compared with their distance from the cable. Prof. Jamieson is probably quite right in believing that the currents in this circuit do not produce much effect in the cable. But a considerable proportion of the return current from the tramcars does not pass along the rails, but through the ground, and the path of some of this will be close to the cable. The relatively high conductivity of the iron pipe in which the subterranean line is laid, and of the sheathing of the submarine cable, will tend to concentrate these stray return currents close to the cable, and so aggravate the effects.

When Mr. Trotter considered the question he was inclined to attribute the effect observed to the first part, the electro-

static action. The capacity between the cable conductor and the earth consisted of two parts, that of the core itself and that of the terminal condensers. Since but a few miles of the cable could possibly be considered as coming within the range of action of the tramway currents, the capacity of the terminal condensers was evidently by far the most important part, and it was at the earth connection of these condensers that variations of potential were to be guarded against. It was consequently inferred that if an earth connection for the terminal apparatus could be obtained at some point beyond the reach of the tramway currents the disturbances would cease, and experiments were made for the purpose of testing this conclusion by carrying out lines in different directions from the cable office so as to obtain a working earth at some undisturbed point. This expedient proved useless, except in the case when the earth line was carried out to sea nearly along the line of the existing cable. This result might have shown that the cable disturbance was not due in any considerable degree to the electrostatic action contemplated, and that the improvement was the result of eliminating electro-magnetic action by the provision of a differential or balanced circuit in the region of disturbance.

Even this compensation has not proved satisfactory now that the tramway system has been extended, an effect explained by Prof. Jamieson as due to the fact that the circuit obtained was not perfectly differential, because the routes of the main and the earthing cables were not closely coincident, and because the two cables were not of similar construction.

It was recommended accordingly that the main cable and the earth return should be constructed as a symmetrical twin core cable. In the interests of the tramway company it was suggested that two or three miles of such a cable would be sufficient, one core being earthed at the end by connection to the sheathing, and the other jointed to the main Mosammedes cable. The cable company, however, very naturally insisted that the twin cable should be carried out 10 N.M. to Robben Island, where the main cable from Mosammedes, as well as the twin cable from Cape Town, can be landed, so that all the ends are available for disconnection and testing.

When this has been completed, the circuit may be looked on as carried into Cape Town, and then, after passing through the instruments, returned upon itself to Robben Island, where it is earthed. The earth will then be obtained at a point free from changes of potential due to the tramways, while the whole of the line in the region of disturbance will be so balanced, that there can be no effective disturbance produced. With such a construction it is quite immaterial whether the disturbances have been due to electrostatic or electro-magnetic induction, since the balance is equally a remedy against both, and there can be no doubt that it is a perfectly effective mode of meeting the difficulty. We do not quite follow Prof. Jamieson in his statement that an iron pipe, or sheathing armour, forms a magnetic shield against the effects of changes in neighbouring currents, otherwise than in virtue of their electric conductivity.

Information as to the mode of duplexing such a cable would be interesting. It is clear that if the second core were used, not for the working earth connection, but as a connection to the artificial cable, it would be equally efficient in preventing disturbance (possibly with a landline for a distant working earth in addition), and then the ordinary methods of duplexing would be available. It would be impracticable, we suppose, to operate the cable at Cape Town with the artificial at the other end of the second core at Robben Island. If the second core is used for the working earth, the tramway disturbances will only be eliminated in simplex working.

The difficulty of using delicate electrical and magnetic instruments near places where large currents are employed is very great, and the best course, where it is practicable, is to take them away. The expense of removing a large existing cable station is serious, and it is convenient to receive messages in the place where many of them have to be delivered, or we imagine that the cable company might have been tempted to move their station from Cape Town to some other place free from disturbance, and to employ ordinary telegraph apparatus to reach the distributing centre. It is quite clear that the convenience of a cable company is not comparable in importance with the interest of the general public in electrical tramways, and we should be sorry to hear that such difficulties as those with which Prof. Jamieson has been dealing, were allowed to hamper electric traction schemes. Similar considerations apply to scientific laboratories, and it seems not unlikely that the new magnetic observatory in Greenwich Park, and the proposed development of the Kew Observatory may ultimately create difficulties of the same kind. The vested interests of the instruments in the City and Guilds Institute were allowed, if we remember rightly, some weight in procuring the rejection of a proposed underground railway in London.

## WIRING RULES AND SUPPLY REGULATIONS.

Under this head we dealt with the September, 1898, issue of the "Regulations as to the supply of electrical energy to be observed by consumers and electrical contractors," issued by the Manchester Corporation, and bearing the name of the chief engineer, Mr. C. H. Wordingham, and in our issue of October 7th, 1898, questioned the wisdom of worrying consumers over every little detail of their installation. Mr. Wordingham's general views on the subject of standardising and testing fittings were given at length in his Municipal Electrical Convention paper of 1896 on "The Control by Municipal Authorities of Consuming Devices and the Wiring Connecting them to the Mains." Shortly after our article appeared, a further contribution to the subject was afforded by Mr. Wordingham's Institution of Electrical Engineers' paper on "The Regulation of Wiring Rules." He there alluded to the system of testing and registration of such fittings as fuses, switches, ceiling roses, wall sockets, and lampholders, which he had introduced into Manchester, and which was covered by the September, 1898, issue of the "Rules." This was probably the first time in this country that examination and registration of the various designs of fittings was attempted, and after that date only those fittings were allowed to be used which had passed certain definite tests set forth in the regulations.

In January, 1899, Mr. Wordingham was able to say that although this system had only been in operation for a few weeks, "the results were eminently satisfactory." Experience with the system extending over a year has now been obtained, and it is interesting to find that, in addition to the wiring rules, the Corporation now issue a "List of Approved Fittings," containing a fairly complete set of fittings with a good choice of makers for installations of practically every size. What is most satisfactory is, that we learn from Mr. Wordingham that manufacturers have shown every willingness to adopt suggestions in the spirit they were intended, *i.e.*, to conduce to the improvement of the fittings.

There has undoubtedly been a marked improvement during the past year in the design, but, perhaps, more particularly in the detail construction of switches, roses, wall plugs and lampholders, and those firms whose names appear in this "list of approved fittings," have done extremely well in this forward movement. Manchester is rapidly becoming the electrical centre of gravity of England, and although it would be difficult to say exactly how much influence the Corporation system of testing and registering has had upon the accessories' trade, there is no doubt that it has assisted in ridding the market of some of the flimsy, poor, "cheap and nasty" fittings which were only too frequently seen two or three years ago.

The only question is whether this registration should not be so arranged as to free the consumer from worry. The recent debate on standardisation and the tendency to reduce types and patterns to a minimum will greatly aid the movement, because there will be fewer separate things to test and register, and therefore less risk of interfering with the public convenience. Again, as fittings identical with those registered as "approved" may be fixed on circuits to be connected to the Manchester supply, without the actual fittings being submitted to the city electrical engineer, the system at work resolves itself into an enforced standardisation, by eliminating the unfit. Given that it has been carried out with tact and discretion (as must have been the case), and that its future development will be on similar lines, there is

every credit due to Mr. Wordingham for his boldness and enthusiasm in proceeding along a path that must have been beset with many troubles and worries at its initial stages, but which must react favourably upon the class of accessories used in wiring work throughout the country.

The actual samples approved include 116 patterns of switches, 51 of cut-outs, 27 of distribution boxes, 47 of ceiling roses, 13 of wall plugs, 4 of lampholder plugs, 31 of lampholders, and 3 of lampholder switches, amounting to about 300 different patterns and types in all. The range covered, and general classes of apparatus tested and approved, are indicated in the attached summary of the list which we have prepared, it being of interest to see exactly what sizes are regarded as of most use, and how many different kinds of the most commonly used fittings one has to select from. For one year's work this result is not at all bad. One is not told, but it would be interesting also to learn roughly the percentage of "failures" to "passes."

We have before us copies of the "Regulations" for one or two issues during the past six years. Thus in September, 1894, only 20 pages were required; in July, 1896, 27; in September, 1898, 33; and in October, 1899, no less than 36. We sincerely trust, for the sake of the wiring contractor and Manchester tradesman, that this rate of increase will not be continued, for, as a contractor recently pathetically explained to us, "I must do *some* work; I dare not spend *all* my time reading wiring rules and mastering the differences between the requirements of one place and those of another."

But few additions and alterations have been made in the last edition of the regulations. One useful addition is as follows:—"In those cases where the Corporation supply is used as a stand-by to the consumer's own generating plant, the lamps must be divided up into circuits not exceeding 2½ KW., and each circuit must be provided with a separate throw-over switch, so that it shall be impossible for more than 2½ KW. to be thrown over to the Corporation mains at one instant." The only variation from the older rules as regards testing of fittings is that if the net selling price of a fitting exceeds 10s., the tested fitting will be returned to the manufacturer if he desires it. An error of the compositor, giving ·002 inch, where it should be ·02 inch, as the thickness for pure rubber insulation, has been corrected, but the absurd requirements as to earthing all electric heating apparatus and standing it on stone or incombustible material at a distance of 20 inches away from combustible substances, and 6 inches clear space between the bottom of the radiator and the stand, have been retained. Otherwise the rules are of value, and we urge our readers to procure a copy and read them over; the time would be usefully spent.

### Summarised List.

| Current. | 100 volts. | | 200 volts. | | 400 volts. | | Remarks. |
|---|---|---|---|---|---|---|---|
| | S.P. | D.P. | S.P. | D.P. | S.P. | D.P. | |
| ·35 | ... | ... | 2 | ... | ... | ... | Switches. |
| ·50 | ... | ... | 1 | ... | ... | ... | |
| ·60 | ... | ... | 1 | ... | ... | ... | |
| ·75 | ... | ... | 2 | ... | ... | ... | |
| 1·00 | ... | ... | 5 | ... | ... | ... | |
| 1·50 | ... | ... | 2 | ... | ... | ... | |
| 1·70 | ... | ... | 2 | ... | ... | ... | |
| 2·0 | 2 | ... | 4 | ... | ... | ... | |
| 2·5 | 1 | ... | 5 | 2 | ... | ... | |
| 3·0 | 7 | ... | 6 | ... | ... | ... | |
| 4·0 | ... | ... | 1 | ... | ... | ... | |
| 5·0 | 7 | 3 | 8 | 5 | ... | ... | |
| 6·0 | 2 | ... | ... | ... | ... | ... | |
| 7·0 | 1 | ... | ... | ... | ... | ... | |
| 8·0 | 1 | ... | ... | 1 | ... | ... | |
| 10·0 | 4 | 2 | 2 | 5 | ... | ... | |
| 15·0 | 1 | ... | 3 | 2 | ... | ... | |
| 20·0 | 1 | 2 | ... | 3 | ... | ... | |
| 24·0 | 1 | ... | ... | ... | ... | ... | |
| 25·0 | ... | 1 | 3 | 6 | ... | ... | |
| 30·0 | ... | ... | 1 | ... | ... | ... | Also five special resistance switches. |
| 50·0 | ... | ... | 3 | ... | ... | 1 | |
| 75·0 | ... | ... | 1 | ... | ... | ... | |
| 100·0 | ... | ... | 1 | ... | 1 | ... | |
| 120·0 | ... | ... | 1 | ... | ... | ... | |
| 1 | ... | ... | 1 | ... | ... | ... | Cut-Outs. |
| 2 | ... | ... | 1 | ... | ... | ... | |
| 3 | 3 | ... | 1 | ... | ... | ... | |
| 5 | 2 | 6 | 2 | ... | ... | ... | |
| 6 | ... | ... | 1 | ... | ... | ... | |
| 8 | ... | ... | 1 | ... | ... | ... | |
| 10 | 4 | 6 | 3 | 1 | ... | ... | |
| 15 | 1 | ... | 1 | ... | ... | ... | |
| 20 | 3 | 7 | 1 | ... | ... | 1 | |
| 30 | 1 | 2 | ... | ... | ... | ... | |
| 50 | ... | 1 | ... | ... | ... | ... | |
| 100 | 1 | ... | ... | ... | ... | ... | |
| 2·5 | ... | ... | 1 | 1 | ... | ... | Distribution Boxes. |
| 5 | ... | 2 | 1 | 11 | ... | ... | |
| 6 | 1 | ... | 1 | 1 | ... | ... | |
| 10 | 2 | 2 | 2 | ... | ... | ... | |
| 12 | ... | ... | 1 | ... | ... | ... | |
| 15 | ... | ... | 1 | ... | ... | ... | |
| ·5 | ... | ... | ... | 2 | ... | ... | Ceiling Roses. |
| ·6 | ... | ... | ... | 2 | ... | ... | |
| ·7 | ... | ... | ... | 2 | ... | ... | |
| 1·0 | ... | 5 | ... | 14 | ... | ... | |
| 1·75 | ... | 1 | ... | ... | ... | ... | |
| 2·0 | ... | 1 | ... | ... | ... | ... | |
| 2·5 | ... | ... | ... | 3 | ... | ... | |
| 3 | ... | 2 | ... | 6 | ... | ... | |
| 5 | ... | 2 | ... | 6 | ... | ... | |
| 8 | ... | 1 | ... | ... | ... | ... | |
| ·5 | ... | ... | ... | 1 | ... | ... | Wall Plugs. |
| ·6 | ... | ... | ... | 1 | ... | ... | |
| 1·0 | ... | ... | ... | 1 | ... | ... | |
| 2·0 | ... | 2 | ... | 1 | ... | ... | |
| 2·5 | ... | ... | ... | 1 | ... | ... | |
| 3·0 | ... | ... | ... | 2 | ... | ... | |
| 5·0 | ... | ... | ... | 4 | ... | ... | |
| 1 | ... | 2 | ... | 1 | ... | ... | Lampholder Plugs. |
| 1·5 | ... | 1 | ... | ... | ... | ... | |
| ·5 | ... | ... | ... | 1 | ... | ... | Lampholders. |
| ·6 | ... | ... | ... | 1 | ... | ... | |
| ·7 | ... | ... | ... | 1 | ... | ... | |
| 1·0 | ... | 1 | ... | 17 | ... | ... | |
| 1·5 | ... | ... | ... | 3 | ... | ... | |
| 1·75 | ... | 1 | ... | ... | ... | ... | |
| 3·0 | ... | 1 | ... | 3 | ... | ... | |
| 5·0 | ... | 2 | ... | ... | ... | ... | |
| ·65 | ... | ... | ... | 1 | ... | ... | Lampholder Switches. |
| 1·00 | ... | 1 | ... | 1 | ... | ... | |

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

3,693. "Improvements in secondary batteries." H. Korten. Dated February 26th.

3,731. "Improvements in the manufacture of electrically-conducting material." E. Sander. Dated February 26th. (Complete.)

3,753. "Improvements in and relating to electrical secondary batteries." E. N. Commelin and R. A. Viau. Dated February 26th. (Complete.)

3,762. "The application of steatite to electrical purposes as an insulating material." F. de Mare and E. Fremy. Dated February 27th.

3,789. "Improvements in telephone transmitters." E. B. Fahnestock. Dated February 27th. (Complete.)

3,821. "The electrical referee." W. Davey. Dated February 27th.

3,834. "Improvements in and relating to electric generators and motors." N. W. Storer. Dated February 27th. (Date applied for under Patents, &c., Act, 1883, Section 103, July 28th, 1899, being date of application in United States.)

3,854. "Recording and indicating pyrometer galvanometer." A. Hill and J. Tatlock. Dated February 28th.

3,886. "Improvements connected with fire alarm thermostats." T. M. Heaphy. Dated February 28th.

3,913. "Improvements in or connected with the metering of electricity." A. Wright and The Reason Manufacturing Company, Limited. Dated February 28th.

3,917. "Improvements in electricity meters." J. Lorwa. Dated February 28th.

3,922. "Improvements in holders for electric glow lamps." J. H. F. Krull. Dated February 28th.

3,933. "Improvements in the method of and apparatus for reversing the trolley in electric tramcars and other like vehicles." J. W. Oldfield. Dated March 1st.

3,937. "Electric feeder log." W. Thomson, Baron Kelvin. Dated March 1st.

3,949. "An improved electrical speed indicator." R. F. Collinge and R. J. Collard. Dated March 1st.

3,961. "Improvements in and relating to electric traction." F. A. Wilkinson. Dated March 1st.

3,968. "Improvements in recording instruments for electric telegraphs." A. Muirhead and R. H. Edgar. Dated March 1st.

3,969. "Improvements in electric switches." W. F. Jones. Dated March 1st.

3,981 "Improvements in apparatus for switching on and off lamps in electrical illumination, particularly in advertising." A. F. Biddle. Dated March 1st.

3,992. "Improvements in voltmeters." W. L. Wise. The Actien Gesellschaft Electricitätswerke (vorm O. L. Kummer & Co.), Germany.) Dated March 1st.

3,993. "Improvements in electricity measuring instruments." W. M. Mordey. Dated March 1st.

4,002. "Improvements in or connected with electrical switches." W. S. Brentnall and E. Brentnall. Dated March 2nd.

4,022. "Improved means for use in the distribution of electric current in electric road traction." E. B. von Mairhofen. Dated March 2nd.

4,026. "Improvements in electricity meters." J. Lea. Dated March 2nd.

4,038. "Improvements in electrical resistances." B. Hopkinson. Dated March 2nd.

4,046. "Improvements in or connected with fusible cut-outs for electric installations." C. A. Hemingway and R. J. Coley. Dated March 2nd.

4,105. "Improvements in electric tramways." B. J. B. Mills. (E. Bonnet, J. Paufique, and G. Liniere, France.) Dated March 3rd.

4,109. "An improved electric clock." F. W. Golby. (H. Hansen, Germany.) Dated March 3rd. (Complete.)

## ABSTRACTS OF PUBLISHED SPECIFICATIONS.

**Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 323, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).**

### 1897.

**28,026. "Improvements in the covers or domes of the switches of electrical glow lamps, which improvements are also applicable to other electrical switches." H. C. Evered.** Dated November 9th, 1897. Covers for switches for glow lamps or other purposes are lined or coated internally in order to prevent short-circuiting. The lining may be of rubber or vulcanite or the like, moulded to the desired shape and applied while still plastic to the cover. Instead of applying a fashioned lining, the surface may be coated with rubber solution, or a coating of varnish or drying linseed oil may be applied. 3 claims.

**26,040. "Improvements in the construction of electrical transformers for use in three-wire systems." The British Thomson-Houston Company, Limited, and H. M. Hobart.** Dated November 9th, 1897. Relates to transformers for use on three-wire systems of distribution. The primary coil is wound between Sections 1, 2, 3 and 4. The sections are in series on one side of the balancing wire and on the other side. 1 claim.

**26,057. "Improvements in or connected with porous cells or receptacles for galvanic batteries." M. M. Bair.** Dated November 9th, 1897. Porous cells are, when not in use, protected against the action of the atmosphere by providing them with a temporary covering of paper, woven fabric or the like which can be readily torn off, or the covering may be made of such a nature that it will dissolve in the battery fluid. 1 claim.

**27,566. "Improvements in electrical fusible contacts." G. Byng.** Dated November 24th, 1897. In order to minimise the dangers from arcing, the fuse wire is led through a chamber or compartment lined with a refractory material which will not volatilise at the high temperature of the arc. The base, cover, &c., may be of china or the like, with suitable partitions covered or lined with plaster of Paris, cement, fireclay, &c. In modifications, the fuse wire is led through a tube or handle suitably lined. 3 claims.

**27,619. "Improvements in incandescent electric lamps." R. Nordmann.** Dated November 24th, 1897. Incandescent lamps.—The body of a lamp consists partly of a lens attached by fusion. The filament is made of a sinuous form in a plane near the lens. 2 claims.

**27,683. "Improvements in and connected with electrical storage batteries." W. H. Lake.** Dated November 25th, 1897. Relates to that form of plate or electrode in which spirally-wound plugs of lead foil are placed in apertures in a lead plate or grid, and consists in compressing these plugs at one or more points so as to form necks or bosses. One form is shown of a plug compressed at two points to form one neck, and another form of plugs compressed at three points to form a trefoil are shown in place in correspondingly shaped apertures in a grid. The apertures in the grid are so shaped that they lie closely against the necks or bosses, and the two may be burnt together at these parts. 3 claims.

**27,707. "Improvements in electro-metallic depositing apparatus." J. E. Hartley and H. E. Hartley.** Dated November 25th, 1897. Rotary motion is imparted by a pulley to a vertical shaft from which the cathode and anode are carried. The cathode consists of a non-conducting rim with a wire network upon which the work is placed, and is carried by chains or cords from the hook which is encircled by the non-conducting sleeve. The current is conveyed to the articles by the wire, non-revolvable collar, central hook, rod and wire. The anode consists of a plate supported by rods from the carrier, and electrically joined up by the wire, loose collar, revolvable collar in electrical contact with the loose collar and wire. A second upper anode plate may also be used, being carried, for example, by cords, and connected up by the wire. The lower edge of the rim has a cam-like surface, which runs over a fixed roller to impart a shaking motion to the articles under treatment. The whole apparatus described may be readily immersed into or raised from an electrolytic bath. In a modification a central vertical rotating anode is used, and the articles are carried from hooks on the encircling cathode rim. A motor of the roasting-jack type may be used to rotate the apparatus. 5 claims.

**27,725. "Improvements in the construction of accumulators or secondary batteries." H. Leitner.** Dated November 25th, 1897. The plates are made of a thin central plate of lead, coated with active material described in Specification No. 780, A.D. 1896, which in turn is covered with perforated plates or celluloid or like resilient material. Bars of celluloid, rubber or other resilient material are placed between the plates, and a bundle of plates is tightly packed in a case of resilient material, or is surrounded by bands of the same material. The object of the resilient material is to cause the plates to expand and contract under pressure. When the plates of one polarity consist of lead sheets coated with zinc, these plates are placed between the other plates in such a manner that the pressure exerted on the latter does not affect the former. In the provisional specification the plates are described as constructed of active material placed between two perforated lead plates. 5 claims.

**27,749. "Improvements in arc lamps." W. J. Davy and G. Thomas-Davies.** Dated November 25th, 1897. Relates to cluch arc lamps. The frame of the lamp consists of a dome, an insulator, a central tube, a chamber made in two parts and screwed together, and two rods depending from either the upper or lower part of this chamber to support an open yoke. An insulator supports an outer casing. An outer globe is supported by a nut and screw on a cross bar which rests in notches in the yoke. The inner globe and lower carbon are carried by a holder on a spring in the cross bar, the globe being thus held in a packed groove in the chamber. The upper carbon is inserted in a guide which slides in an inner tube, the guide and inner tube have obtuse conical tops carrying balls or segmental pieces to maintain electrical connection. The upper carbon passes between two jaws carried by pairs of links, which are pivoted together and hung by other links from a collar and disc on the end of the inner tube, so that, when they are lifted from the bottom of the chamber, they grip and lift the carbon. The inner tube is linked to a dash-pot which is hung by cords from guides carried by the tube, the outer ends of the cords being attached to a sliding ring; this supports a core above two series coils, and a similar core below two shunt coils, carried by a tube. The piston of the dash-pot is also supported by this tube. A series resistance is held between the dome and a lining. 5 claims.

**27,765. "Improvements in electric arc lamps." T. Spencer.** Dated November 25th, 1897. "An alternating current clutch lamp is arranged with the arc in a small closed globe. The lower carbon is fixed on the lamp frame. The upper one is carried by a square rod, one edge of which is toothed, and which can slide up within a tube. This tube also slides vertically, and is attached at its upper end to the piston of a dash-pot. The tube carries a core, within a series coil, which is embraced by four bundles of iron plates; these are clamped adjustably on four vertical rods. This adjustment relatively to the core varies the inductance of the series coil and enables the lamp to be used with currents of different frequencies. The tube carries a pivoted lever which is held in engagement with the teeth on the rod by a spring, except when it bears on the base-plate. The tube also supports on two spring-pressed links a brake block which bears frictionally on the opposite angle of the rod, except when it is raised by contact with the tail of the lever. These parts, operated by the core, effect both the striking of the arc and feeding of the carbons. In order to provide a large current, in striking the arc, a part of the series coil may be short-circuited when the core is lowered sufficiently, by a tumbling switch touching an insulated contact. The switch is operated by pins on it being engaged by a disc on the tube and carbon contacts are used. 11 claims.

**27,805. "Improvements in electric lampholders." A. Watson.** Dated November 25th, 1897. Relates to holders for incandescent lamps provided with switches. The insulating body of a holder is provided with two rectangular recesses. Openings are provided to receive connecting blocks and plungers, which may be such as are described in Specification No. 27,482, A.D. 1896, for a bayonet-capped lamp; the casing of the holder is in two parts connected by a screw-threaded ring. These blocks and plungers are attached to four springs, which are connected by metal strips on two insulators carried by a shaft, when this is turned by a key, mounted in the casing, so that the tips engage behind the bent ends of the upper springs. A spiral spring, mounted in an insulating body, between the parts, is attached to the shaft, and tends to retain these parts in the position normal, in which the lamp is entirely disconnected. 4 claims.

**27,806. "Improvements in electrical switches." A. Watson.** Dated November 26th, 1897. The contact arm which may be formed of a single strip of metal bent in the middle, has its free ends bent inwards and normally slightly apart. When the arm is forced down between the fixed contacts or terminals, these ends are forced together and give a good connection. The arm and also the handle are pivoted on a cross pin. The handle is fitted with a shoe or collar which gives a positive movement to the contact-bar, a spring giving a quick break. For double pole switches, two contact bars are mounted on a spindle which is operated by a single handle. 3 claims.

**27,807. "Improvements in, and in the manufacture of switches for electrical purposes." A. Watson.** Dated November 26th, 1897. Relates to the support or bearing for the ball of the handle or lever in tumbler switches. The bearing chamber for the ball is formed of a cap open at the top, and a cup secured by soldering or otherwise in the cap. The cup is slotted to allow for the movement of the lower limb. The cup may have downwardly projecting ears which are soldered or otherwise secured to the supports. 2 claims.

**27,868. "Improvements in electric furnaces." C. S. Bradley.** Dated November 26th, 1897. Electric furnaces are arranged so that the product, such as calcium carbide, may be continuously moved away from an electrode or electrodes. In the arrangement described, a wheel having an open semi-circular rim is carried by a shaft, and rotated slowly by worm gearing and an electric motor. A wheel 15 feet in diameter may rotate once in five days. The lower half of the rim is closed by latching semi-circular sections to the descending side, and is filled with the powdered materials, supplied from a shoot and box. Leakage is prevented by placing strips of sheet-iron within the sections at the joints. An electrode which may be a carbon rod 4 inches in diameter, is supported adjustably by a rotatable nut on a stand. A core of carbon is placed in the wheel, and becomes replaced by a core of conducting product of the furnace. Connection is made with the core by copper bolts, a commutator and stationary brushes. When the product does not conduct sufficiently well, the current is passed between two electrodes supported obliquely within the open end of the closed part of the rim. The rim sections and the core are removed at the rising side of the wheel, the unconverted materials surrounding the core falling to an elevator which returns them to the box. 7 claims.

**27,870. "Improvements in dynamos and motors." A. W. Smith.** (Date claimed under Patents, &c., Act, 1883, Sec. 103, May 3rd, 1897, being date of application in United States.) Dated November 27th, 1897. Dynamos and motors are modified in the construction and winding of the field-magnets to limit or obviate the distortion of the field when the machine is running with various loads. One arrangement is described in which the field magnet cores are arranged with the coils wound in gaps separated by projections throughout the rear half of the magnet. A neutral gap is formed in the commutating position, and the pole-piece is immediately in front. Small opposing electro-magnets are placed in the gaps so as to equalise or reduce the electromotive force of the self-induction at the points of commutation or prevent sparking. The commutator is cross-connected. The magnets may have sets of projections in front and behind the neutral points, two sets of coils being employed so as to drive in both directions. Single coils may be employed on each magnet, the neutral gaps being also sometimes omitted. In a further modification, in which projections are employed on each end, a winding may be placed on the leading projections, each coil of which passes through the neutral gap. 13 claims.

**27,895. "Improvements in or connected with devices for protecting electric circuits and apparatus from injury by excessive electrical potential due to lightning or other cause." A. E. Fynn.** Dated November 27th, 1897. Apparatus for protecting electric circuits from the effects of excessive potential such as lightning discharge are formed with two sets of carbon contact points connected to line and earth respectively. The contact points are separated by sufficient space to receive the cross end of a frame carrying two other sets of points, thus forming two sets of spark gaps. The frame is mounted on a shaft provided with a chain wheel, the chain of which carries an armature at one end and a weight at the other. The shaft is connected through a resistance to the magnet, the other end of the magnet coil being connected to earth. In use with alternating currents the resistance is preferably non-inductive, and a condenser may be arranged in a parallel earth connection. Buffers are employed to limit the motion of the frame and weight. 3 claims.

**28,159. "Means for use in lighting railway cars or carriages by electricity and for regulating the current for the same." S. Watkins. (American Railway Electric Light Company.)** Dated November 30th, 1897. The generator is carried on the axle of the car, and means are provided for automatically regulating the current and for maintaining its flow constant as to direction, though the rotation of the armature be reversed. A bearing sleeve is also described for carrying the armature. The dynamo is enclosed in a casing, and is supported partly by the axle, and partly from the under-carriage of the truck, a lug on the frame resting on a spring carried by the pendent. The current is regulated by varying a resistance in the field-magnet circuit, an arm being moved over the contact disc by a ratchet mechanism controlled by an electro-magnet in the main circuit. The core has a movable core pivoted at the bottom to an arm and normally forced upwards by an adjustable spring. A shaft rotated by worm gearing from the armature, carries a crank engaging with a fork on a rocking shaft carrying pawl fingers adapted to engage when in the proper position with one or other of the reversed ratchet wheels, on the shaft of which the contact arm is carried. When the current exceeds the limit, a core with its extension is drawn down, allowing a finger to engage a wheel which causes resistance to be put in circuit. When, however, the current falls, the core rises under the action of the spring and one of the fingers comes into play and cuts out resistance. In order to automatically reduce the action of the spring when the lights are in use, a magnet is included in the circuit, its armature being attached to a lever which is connected at one end to the spring. The current is kept constant as to direction in the external circuit by a rocking reversing switch which is controlled by means of a sleeve, having a helical groove in which works a stud connected to the switch arm. 9 claims.

**28,268. "Current collectors for electric railways with overhead wires." J. Tamar.** Dated November 30th, 1897. Collectors for use with overhead conductors. The rubbing surface consists of loose rollers with ball bearings interposed and strung on a shaft. 2 claims.